CONSTRUCTIONAL DETAILS

By

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GENERAL EDITOR'S FOREWORD

THE AIM of the Teach Yourself Building Series is to assist those who are desirous of acquiring information concerning building methods and practice.

It is not intended that these books will take the place of textbooks or recognised courses of study at Technical Colleges, but they should appeal to all students of building because each volume has been written by a specialist in his own particular subject.

The series covers almost every branch of the building crafts and allied professional practice.

In placing before the public this comprehensive work on Building, no apology is necessary for continuing to describe and illustrate traditional methods of building construction, because it is of vital importance that the layman who desires to become acquainted with building technique should be instructed in the basic principles of building.

There is really very little difference between traditional methods of building and the form of construction which has been developed to meet the requirements of the immediate post-war era. As pre-fabrication and standardisation will be the main features in the construction of post-war buildings, these materials and methods have been described and illustrated within the framework of this series, but no attempt is made to theorise on their comparative values.

The text has been written in a clear, concise and interesting manner, and the constructional details throughout the series are portrayed by clear line diagram drawings.

The details illustrated throughout this volume are presented in pictorial form to assist those who are unable to visualise a complete unit from plan, elevation and section.

A chapter is devoted to describing and illustrating the operations for the erection of a small building and the procedure which is usually adopted to obtain the correct quantity of material for the completion of the work.

EDITOR.

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CHAPTER I

PRELIMINARY OPERATIONS

Survey of Site—Access

Before building operations are commenced the condition of the site should be studied in respect to access and disposition of adjoining roads. Entry to the site should be made where it is most convenient for delivery of materials, which should be placed in such positions, if the space allows, as to obviate rehandling. The entry that has been chosen may require a temporary roadway; this may be constructed with second-hand sleepers, or, if the natural ground is firm, by spreading hardcore over the surface and binding it with ballast.

Drains.—The position of the local sewer and the existing drains can be ascertained from the local authority, but these must be located on the site and their condition noted. It may be found necessary in the case of existing drains to take out and renew some of the pipes before the new drains are connected to them.

The sewer must not be cut without the consent of the local authority. Should there be no local sewer it will be necessary to build a cesspool or septic tank to dispose of the soil waste.

Water.—As in the case of the sewer, the position of the local water mains will be given by the local authority. If the position of the permanent main to the building can be fixed, it would be advisable to lay the main, providing the erection of the building will not interfere with it. If this is not possible a temporary main must be laid: the connection to the local main in either case will be done by the local authority or by their consent.

Adequate supply of water is of vital importance and its provision may be a big problem in building work in a country district.

Trial Holes.—If the nature of the soil is not known, trial holes should be dug. The soil thus exposed will determine the type of foundations suitable to carry the weight of building to be erected.

Clearing Site

In the case of virgin sites, bushes and trees are often found which need removing; this is termed "grubbing up." If the site is large enough to warrant the use of mechanical plant, bushes can be removed by a mechanical navvy. Trees will have to be uprooted either by mechanical means or by hand. Care must be taken to see that all roots are removed.

Existing Foundations

Where a building is to be erected on an old site, existing foundations must be located and removed, hardcore being used for back-filling where excavations thus made are not required for the new structure.

Existing structures should be demolished and the materials which can be re-used should be salvaged. Bricks, if not suitable for re-use in the new structure, may be broken up and used for hardcore.

Existing Drains

On old sites, disused drains may be encountered during the process of excavating, and these should be removed. If existing drains in use are encountered they should be diverted if possible. Drains should not be allowed to run under the building, but if circumstances make it necessary for them to do so, cast-iron pipes must be used. Waterways, if on the surface, should be diverted, but when an underground stream is encountered it may be advisable to direct the water through stoneware or cast-iron pipes.

Levelling

Where the ground is sloping or undulating, in order to

save material in foundation work, the site should be levelled, the amount to be removed being governed by the lowest portion of the site and also the means of access. Where only a small portion of the site is lower than the rest, this may be more conveniently made up to the required level with hardcore.

Before building operations commence, the site should be completely surveyed and levels booked; this will enable floor levels to be fixed in relation to roads and means of access.

The instrument most commonly used for the purpose of levelling is the "Dumpy Level," which, when once set up, will only move on a horizontal plane.

A datum point should be fixed for the site, and if not an ordnance Bench Mark, it should be a point which will be stable throughout the building operations. From the datum point all succeeding levels should be related. The site should be grided—that is, divided into squares and levels taken at the points where the lines cross; the position of such points can be obtained by measurement.

In order to find levels by the Dumpy Level, the instrument is set up on its stand and adjustments made until the telescope is perfectly horizontal, which position is ascertained from a spirit-level attached to the instrument.

A staff which is divided into feet and inches is placed on the datum point and the Dumpy telescope focused on to it and the reading taken. Care must be taken that the reading is correct, as the prisms in the level cause the staff to appear inverted. The staff is now moved and placed on the new point, the telescope is turned and focused on the staff again and the new reading taken and booked.

The difference in readings will give the rise or fall of the ground.

Small areas of excavation are most economically excavated by hand, but larger building sites, with the introduction of modern machinery, are better excavated by one of the several types of machine at the disposal of

the contractor—the "scraper" and the "navvy" being the most common machines for this type of work.

Setting Out

Care must be exercised that buildings are set out in accordance with the site plans and that they are related to the neighbouring buildings and roads, as wrong setting out may cause infringement of by-laws or rights.

The onus of setting out is usually on the contractor and any variance from the site plan may have to be rectified at his own expense. The site plan should give measurements from fixed points on roads or boundaries to certain parts of the building. These points should be found on the site and marked with pegs, and from these points site excavations can be executed. The building line should now be fixed and this will give the line for excavating foundation trenches, recesses or projections being marked from the building line. Methods of setting out angles and curves should be studied, but space in this book will not permit anything more than one simple example to be given.

To set out a right angle, the trigonometrical ratio of the sides which are in the proportion of 3, 4 and 5, giving a perimeter of 12, will be found useful, and can be adopted in practice. To do this let 24 ft. be taken as the perimeter, giving the sides of the triangle as 6 ft., 8 ft. and 10 ft. respectively. Place the 6-ft. point of a linen tape on the position where the right angle is required, allowing the 6-ft. length of tape to lie in the direction of the original line. By taking the 24-ft. point on the tape and placing it at the zero point on the tape and taking the 14-ft. (i.e., 6 ft. + 8 ft.) point, and stretching the tape to form a triangle, the angle between the 6-ft. and 8-ft. sides will be the required right angle.

Foundation Trenches

As stated in the previous paragraph, the building or wall

line will give the position of the foundation trench setting out. The excavation line should be marked with a cord stretched from the corner pegs and the digging kept to this line, as in Fig. 1. The depths of the trenches, which are calculated in relation to a fixed datum level, must be noted and measured as the excavation proceeds.

In order to measure from the fixed datum, pegs are driven into the ground until the tops are at the datum level or at a known measurement below datum level. From this point measurements can be taken without the necessity of using the levelling instrument again.

Drain Trenches

Whereas with foundation trenches the bottom of the excavation is level, except for any steppings that may be required, the bottom of a drain trench has a regular fall according to the diameter of the pipe and the run of drain.

This requires a slightly different form of setting out with regard to the fall.

The trench is excavated as nearly to the fall of the drain as possible. Before laying the concrete bed, pegs are driven into the ground at intervals along the length of the drain. The tops of these pegs will be the level of the top of the concrete bed to give the requisite fall. The bed may be laid in line with the pegs.

To counteract any variations in slope, the drain-layer employs the use of boning rods. These may be three pieces of timber in the form of a tee, all of equal length; the first is held in position on the pipe, the second is also held in position on the pipe about 20 ft. away, and the third is held another 20 ft. away. To give an even fall, the tops of the three rods must be in line. Should they not be so, the drain pipes must be adjusted until they are in line. For long lengths of pipe, boning rods on a larger scale may be used. These will consist of a post placed either side of

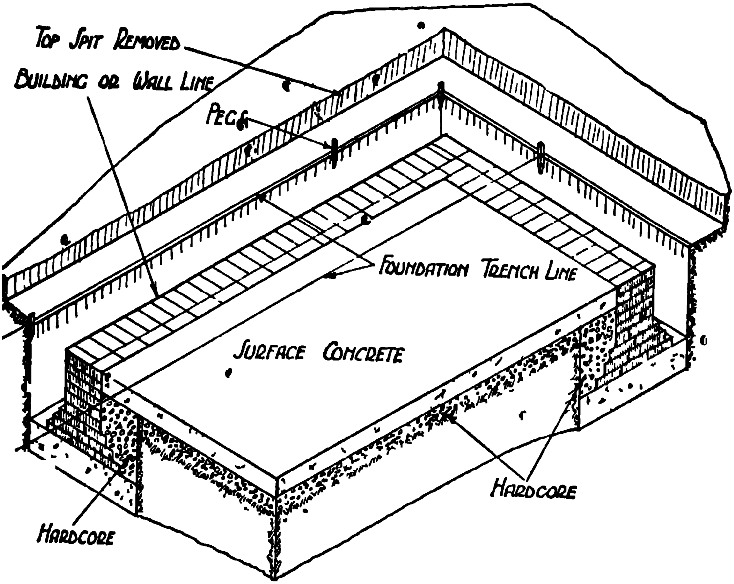


Fig 1 Site & Foundation Trench Excavation

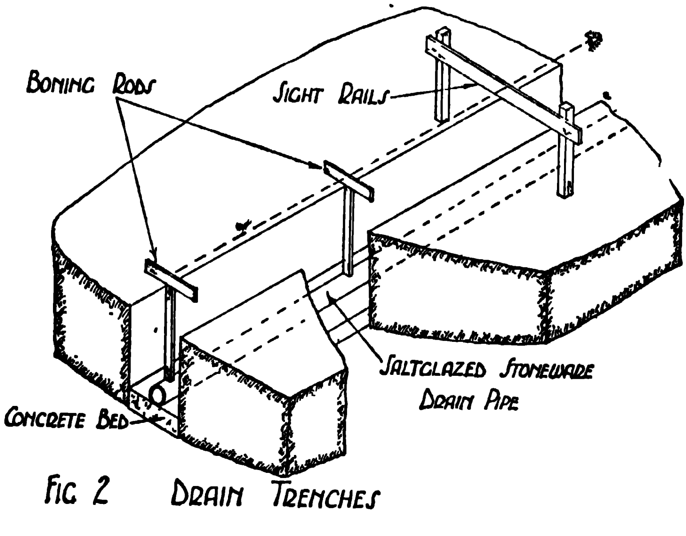


Fig 2 Drain Trenches

the trench, with a board, called a "sight rail," nailed between them at a known level, as in Fig. 2.

At a convenient distance along the run of the trench, two more posts and sight rail are erected, the rail again being at a known level to give the correct fall of the drain. A boning rod, as before mentioned, may be placed between and the level of the drain checked by lining up with the sight rails.

Foundations

Excavations.—Before building work commences, the site should have the top surface removed in order to clear any vegetation that may have accumulated. The reason for this is that if there should be any growth of plants, tree roots, etc., after the building has been erected, the pressure exerted by certain species may affect the foundations. The removal of the topsoil, which is usually soft, will also prevent any risk of settlement after erection of the structure. See Fig. 1.

The depth of such excavations need be no more than 6 in., but frequently this depth is increased owing to the undulating nature of the ground. The combined operation of levelling the site and removing vegetable matter can be carried out together.

Any decayed vegetable matter, or vegetable matter that will decay at some future date, will be a source of weakness in the foundations as settlement may occur.

When a building is to be erected on an old site which has been left for some time, it is still necessary to remove the top "spit," because, although vegetable matter may not be present, it may be that scaffold boards or other timber have been buried, which, if allowed to decay, may be a cause of later settlement of the walls.

To Reduce Levels.—Where it is necessary to excavate below the level of the site excavation, the operation involved is called "reducing levels." This occurs where the ground floor level is below the general ground level, or where a

basement is required, or where the ground below the site excavation is not suitable for building upon. It is necessary to excavate until a good bottom is reached.

A good foundation is ground which will take the load evenly over its surface and which will not be affected by atmospheric or other conditions. Such grounds as clay, if not subject to an undue amount of moisture, or gravel, are usually considered good beds to build upon.

The bearing strength of the ground should be ascertained before commencing building, as the design of the foundations, etc., will in all probability be dependent upon this, more especially if the loads to be carried are heavy. Particulars of the local ground strata, etc., will most likely be available at the local Borough Surveyor's office. Rock beds should be levelled off, if necessary by blasting, and the rock trimmed to receive the concrete foundations. Sand formation may be treacherous and care must be taken to see that it is consolidated and not liable to undermining from underground streams, etc.

Surplus Material

When ground is excavated, the material thrown out increases in bulk; this is caused by the compressed ground being made into individual units, with air pockets between the particles after excavation.

The amount of the bulk increase naturally varies with the nature of the excavated ground, but the increase is usually assumed to be in the region of 25 per cent.

This means that even if the excavated material is to be returned, filled and rammed in trenches, etc., there will still be surplus material which must be cleared.

After excavating, the material is usually moved to spoil heaps; the material that is over after the completion of the building works is spread and levelled around the buildings, making up hollows, etc.

Spreading and levelling is best done by the " bulldozer "

machine, should the size of the job warrant mechanical plant.

When there is still a surplus of material after spreading and levelling is completed, this must be removed to a dump by lorry. Spoil heaps should be so positioned that they are as near as possible to the excavations requiring back-filling, in order to save carting expense. In the case of drain trenches, or any work requiring back-filling, if it is possible the excavated material should be thrown out on to the side of the trench.

Trenches

The width of trenches is dependent upon the width of the foundation concrete, which in turn is dependent upon the thickness of the wall above, the loads to be carried, and the bearing pressure of the ground. In normal cases the width of trench and foundation concrete is 6 in. beyond the bottom course of footings, or, when footings are not being used, an equivalent distance from the faces of the brick wall.

In the case of deep excavations the width of the trench may have to be increased in order to provide working space for the men. It should be noted that the width of the trench must allow for the thickness of planking and strutting required.

The reason for sinking the foundations below the surface of the ground level is chiefly to obtain a foundation bed which will not be affected by atmospheric conditions. The depth will depend upon the type of soil encountered. On the other hand the foundation should not be too deep as this will involve needless expense in excavation and brickwork. The depth in ordinary soils will be approximately 3 ft., while for clay a depth of 4 ft. is often allowed.

Planking and Strutting

When excavating trenches, basements, etc., it may be

necessary to provide timber supports for the earth at the sides so as to prevent it falling in or collapsing.

The type of support will vary according to the ground excavated. Where the ground is moderately firm it may only be necessary to provide a vertical board each side at about 5-ft. centres, with a strut across to support them. These vertical boards are called "poling" boards, as in *Fig. 3.*

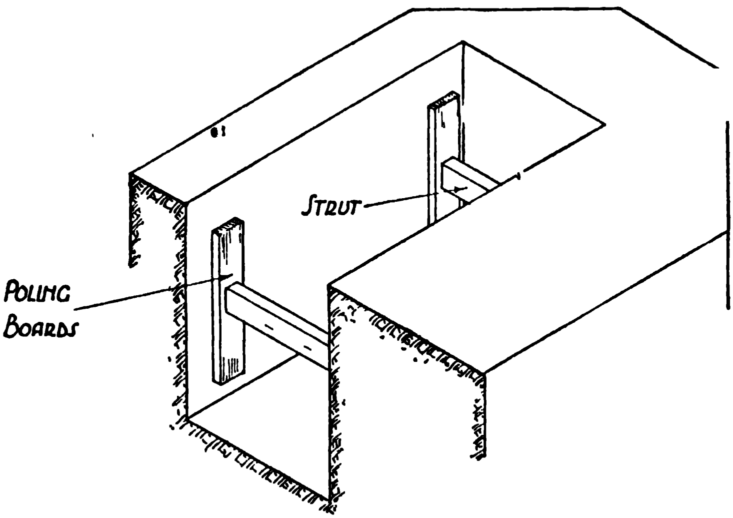
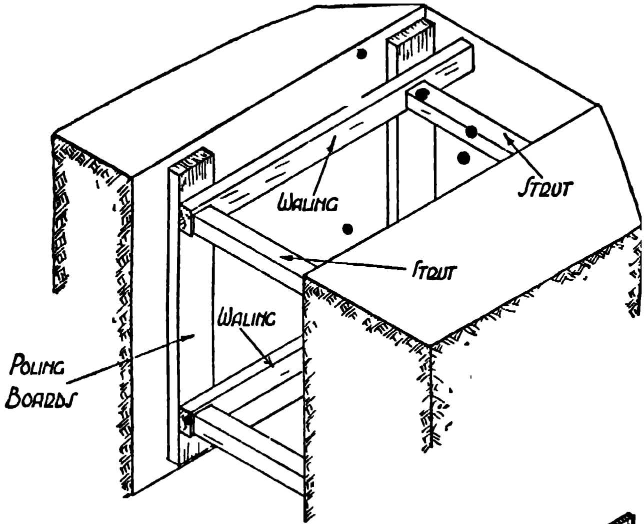


FIG 3 TIMBERING IN FIRM GROUND

With grounds of a loose nature, the poling boards are placed nearer together and horizontal timbers are used to support them. These horizontal timbers are called "walings," and the provision of walings will reduce the number of struts needed, as in Fig. 4. Where the soil is very loose the poling boards must be placed close together to form a continuous face, and thus prevent the loose earth seeping into the trench.

Occasionally running sand may be encountered, and



TIMBERING IN MEDIUM GROUND FIG 4

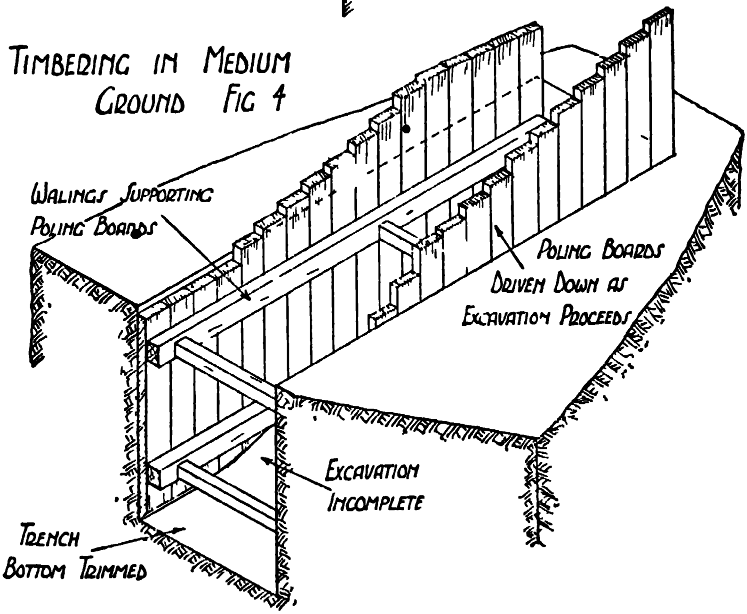


FIG 5 TIMBERING IN LOOSE GROUND

this will have to be dealt with by means of a system of sheet piling. In the case of deep trenches a platform may have to be provided at every 4-ft. depth of trench, in order that the excavated material may be thrown out, and consequently this will mean double or treble handling of the material. The method adopted for putting the poling boards into position is that, after excavating for about 12 in. or more, according to the nature of the soil, poling boards are driven vertically into the sides of the excavation, and as the depth of excavation is increased, they are driven down and walings and struts added as they become necessary, as in Fig. 5. Should the depth be such that more than one "lift" is required, then the trench may be stepped.

Bottoming

Where trenches have been excavated by hand or machine, it is necessary to trim up the bottom of the trench so that it presents a moderately flat face to the concrete foundations. This will ensure that the concrete is of even thickness and that the pressure on the ground is evenly distributed.

Concrete Materials

There are three main materials used in concrete, namely: Portland cement, sand and aggregate.

Cement.—The most common cement used is known as Portland cement. It is an artificially manufactured product, its chief constituents being calcium carbonate, silica and alumina, which are mixed in definite proportions.

The calcium carbonate is obtained by quarrying limestones, the rock being removed from the quarry face and then finely ground.

Silica and alumina, in the form of clay, are mixed into a slurry by the addition of water.

The main ingredients are combined, the proportions of each being adjusted and tested. The slurry is then passed into a rotary kiln, which is a long, inclined steel

cylinder lined with fire bricks. As the slurry passes through the kiln in a downward movement, it is subjected to intense heat, which, as the cylinder rotates, dries the slurry, and the residue is extracted from the bottom end of the kiln in the form of clinker. The clinker is removed, ground in mills, and a small percentage of gypsum is added to regulate the setting time of the cement.

The resultant fine powder is the finished cement, and the extent of its fineness is the determining factor in the quality of the cement.

Rapid-hardening cement or "Ferrocrete" is manufactured in the same way as ordinary cement, the only difference being that it is ground to a finer degree. Rapid-hardening cement will attain in 3 days the same strength as ordinary Portland cement in 28 days.

Sand.—For concrete work the sand should be washed free from clay and be sharp in texture. A "soft" sand is one which, through constant friction, has had all the sharp edges removed. Sharp sand is used for concrete work, since the angular nature of the grains provides a key when mixed with the cement and coarse aggregate.

Aggregate.—This is the term employed for the bulk material in the concrete, and is classified as fine or coarse. The fine aggregate is the sand, while the coarse is composed of ballast, broken brick or stone, which should not be more than 2 in., i.e. it should pass through a 2-in. sieve. The size of coarse aggregate will depend upon the type of concrete work under construction.

The coarse aggregate should be clean and free from any organic or soluble matter, and coke breeze, old concrete, cinders or materials that are liable to crush under normal loading should not be used in foundation work.

The ballast should be clean and free from salt or clay.

For foundation or similar work "all in" ballast is often used, which is excavated from pits and delivered to

the site without screening or grading, and no extra sand need be added when mixing.

This type of ballast is also termed "ballast as raised."

Mixes.—The mix of concrete is governed by the strength required. Thus, when the concrete is to be subjected to compression, as in foundation work, it will only be required to resist the load exerted from above and spread it evenly over the ground. In this case the mix need only be 6 to 1, that is, six parts "all in" ballast to one part cement, known as an ungraded mix.

For making up levels and filling in crevices to form a foundation bed preparatory to concreting, a mix of 12 to 1 (twelve parts "all in" ballast to one part cement) will be found suitable.

Concrete intended for reinforced concrete or similar type of work should be mixed in the proportion of 4: 2: 1, that is, four parts ballast, two parts sand, and one part cement, known as a graded mix.

For this type of work the ballast should be screened through a ¾-in. mesh sieve, because the concrete has to be worked between and around the steel reinforcement.

For finer work such as rendering to brickwork, a mix of 3: 1 (three parts sand to one part cement) or even 1: 1 (one part sand to one part cement) may be used.

The mix of concrete is important, as the finished mass of a graded mix should be homogeneous and free from any voids in its composition. To ensure this, the mix is proportioned so that all voids are filled. The sand should be sufficient to fill all the voids between the ballast particles, and the cement should be the binding medium.

With an ungraded mix where "all in" ballast is used the proportioning of the ballast and sand cannot be regulated, it being assumed that the natural formation of the ballast renders it ready for use. As this type of aggregate is used only in foundation and similar work, the voids not filled will not cause any serious weakness in the structure. This

type of ballast should not be used for reinforced concrete or similar work.

Mixing.—The mix having been decided, the materials have to be combined in the proportions required.

In practice this is done by volume of aggregate and sand to weight of cement. A cubic foot of cement can be taken as 90 lb.

Hand Mixing.—The materials should be mixed on clean boards with no chance of dirt or soil being mixed with the concrete. The coarse aggregate, sand and cement should be placed on the board in the correct proportions and turned over twice dry, after which the water is added in sufficient quantity to make the cement workable, and again turned over twice while wet. It should be remembered that the strength of the concrete is dependent upon the water-cement ratio, that is, it is governed by the amount of water and the amount of cement, and not by the quantity of aggregate. The water used must be clean and supplied through a hose or can with a spray.

Mechanical Mixing.—Concrete is more economically and perfectly mixed by mechanical mixers and these are suitable for the mixing of large or small quantities of concrete.

The proportion of aggregates to cement and water can be accurately measured and the ingredients thoroughly stirred for the correct period of time.

The mixer consists of a framework supporting a drum, which is rotated by a petrol engine. Inside the drum are scoops which raise, cut and stir the materials as the drum turns over.

The aggregates and cement are placed in a hopper which is attached to the framework. When the hopper is raised the material is poured into the drum and the correct amount of water added. The drum is allowed to rotate for two or three minutes and then the concrete is tipped out into barrows and conveyed to the place required.

Sizes of mixers are known by their capacity. The sizes

are 5/3½, 10/7, 14/10. This means that, in the case of the 5/3½, for every 3½ cubic yards of mixed concrete, 5 cubic yards of unmixed material will have to pass through the drum. In the same way, in the case of the 10/7, for every 7 cubic yards of mixed concrete, it will be necessary to pass 10 cubic yards of material through the drum.

Methods.—The concrete should be mixed as near to the position where it is required as practicable to obviate any unnecessary wheeling, and to place it in position before the initial set has commenced.

The British Standard Specification requires that the time for the initial set for Portland cement should not be less than 30 minutes and not more than 10 hours.

A period of 28 days is required for the cement to attain its approximate maximum strength.

When concrete has to be placed in basements or deep foundations it should never be allowed to drop more than 10 ft., otherwise the aggregates will become separated, the heavier particles being at the bottom and the lighter particles at the top, thus disturbing the balance of the mix.

The concrete should be well tamped, that is, a rod should be raised and lowered into the concrete to make sure that no air pockets are left. Should steel reinforcement be inserted in the concrete, this rodding process will ensure that the concrete has surrounded the reinforcement and is binding with the steel. Reinforcement should not be so closely spaced that this cannot be done or that the aggregate cannot adequately surround the rod.

Concrete should not be placed in position during frosty weather.

When concrete has been placed and there is a likelihood of frost, the concrete should be covered with sacks to prevent the frost affecting it. In very hot weather the top surface of the concrete should be kept wet by spraying from a watering can.

Concrete Foundation Bed

A bed of concrete should be formed under the base of walls. The object of this bed is to distribute the load

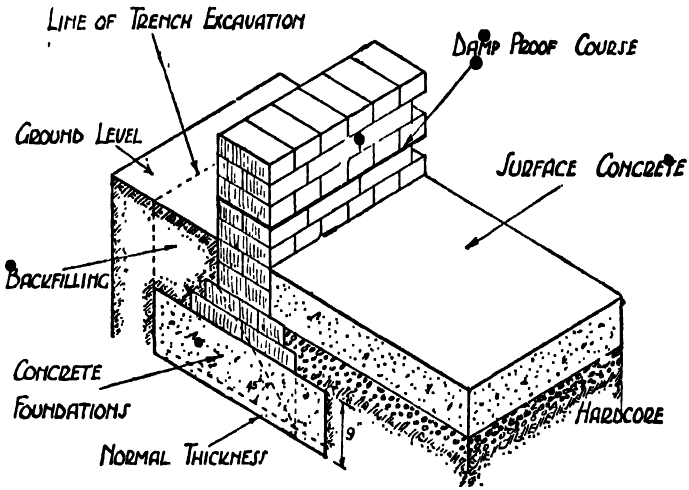


FIG. 6 CONCRETE FOUNDATIONS TO ONE BRICK WALL

exerted by the structure over an area of ground which will safely support it. The concrete bed should not be less than 9 in. thick, and should project at least 4 in. on either side of the lowest course of footings. See Fig. 6.

CHAPTER II

BRICKWORK

Terms

Header.—The shortest side of the brick.

Snap Header.—A half brick as required by the bond, giving a header on the face of the brickwork.

Stretcher.—The longest side of the brick.

Closer.—A brick split lengthways, giving 2¼ in. on the face and used in the bond to form the 2¼-in. lap.

King Closer.—A brick giving a surface 4½ in. on one end and 2¼ in. the other end.

Half Bat.—A brick split in half parallel to the 4½-in. faces.

Quoin.—The external angle made when the face of the brickwork changes direction. The bricks forming this angle are called Quoin bricks.

Course.—The layer of bricks measured from centre to centre of the bed joint. The common height of a course is 3 in., or four courses to 1 ft.

Bed Joint.—The horizontal layer of mortar upon which the bricks are bedded.

Perpends.—The vertical joints between bricks, also known as Cross joints.

Toothing.—The end of the brick courses left with the stretchers projecting 2¼ in. at each alternate course to receive brickwork at a later date.

Reveal.—The return face of brickwork at window and door openings.

Rebate.—The brickwork reduced in thickness to allow for the insertion of frames, etc.

Frog.—The indentation formed on the beds of the brick to act as a key for the mortar.

Break.—The amount a wall is made to project or recess in its length beyond or behind the main wall face.

Chase.—A small recess in the brickwork having three faces and usually formed for the accommodation of pipes.

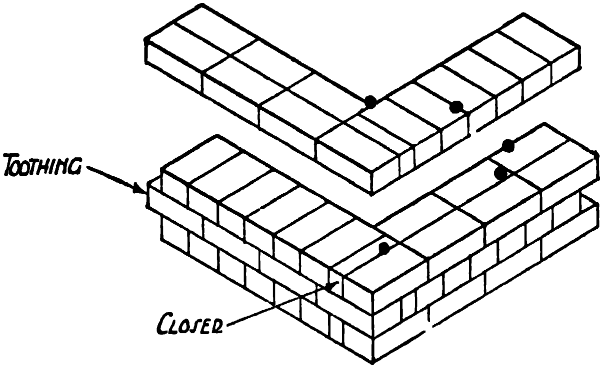


FIG 7 ONE BRICK WALL IN ENGLISH BOND

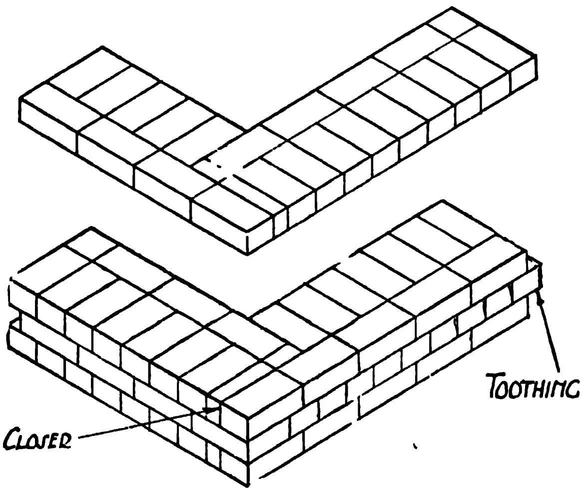


FIG 8 ONE & HALF BRICK WALL IN ENGLISH BOND

Bonds

Reasons for.—The strength of brickwork depends very largely upon the interlacing of the bricks, and this interlacing is known as bonding, the fundamental purpose being that joints running across one course of brickwork shall not have joints immediately underneath or above. The most common bonds have been formed to ensure that the brickwork is acting as a mass and not dependent solely on the mortar joints for its strength.

English Bond.—This bond produces one course of *headers and one course of stretchers alternately on the face of the brickwork. In order to ensure that the vertical*

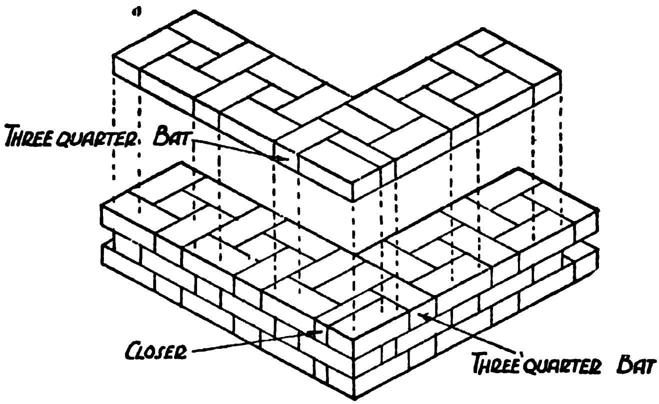


FIG. 9 ONE & HALF BRICK WALL IN DOUBLE FLEMISH BOND

joints do not coincide in alternate courses, a closer is used at the corners in the header course 4½ in. from the angle, that is, after the quoin header. This arrangement will bring the headers in a course central with the stretchers in the course immediately above and below, as shown in Figs. 7 and 8.

Flemish Bond.—There are two types of Flemish Bond, double and single. In *Double Flemish Bond* the bricks

from shale, which is ground, screened and pressed in a semi-dry state. Flettons are made in several varieties, as, for example, grooved Flettons. These bricks have vertical notches on one stretcher and one header face to act as a key for the wall plaster or surface rendering. There are also cellular Flettons made with circular perforations through the bed of the brick. These perforations not only produce a lighter brick but they also act as a key for the mortar bed joints in lieu of the frog.

Stock.—Common bricks are often referred to as stock bricks, but the London Stocks are the particular variety which bear the name. London Stocks are yellow-coloured bricks, the first qualities being suitable for use as facings. They are strong and reliable for use in load-bearing structures. They are manufactured from London clay and are clamp burnt, this process causing the varying qualities of bricks to be manufactured. The second quality are the most suitable for ordinary work where stock bricks are desired.

Engineering.—One variety is known as the Blue Staffordshire brick, which is made from clay containing oxide of iron. These bricks are hard, durable, very heavy, well vitrified and suitable in positions where damp has to be resisted, or very heavy loads have to be carried.

Common is the term applied to any brick which is suitable for mass brickwork or as a backing to facing work, whether the latter is brick, stone or any other type of facing material. Bricks which can be obtained locally are known as " common " or " local " bricks.

Multi-coloured are facing bricks in various colours, giving a pleasing mottled appearance. The colour of the bricks can be governed by the temperature to which they are subjected in burning, and also by the addition of metal oxides and salts during their manufacture.

Wire Cuts are machine-made bricks made from shale or clay and forced through an opening the size of which is the width and length of the finished brick.

The ribbon of clay is cut into a series of units corresponding to brick sizes by wires fixed to a frame, the units later being burnt in a kiln. There are no frogs to this type of brick.

Sand-lime Bricks are really concrete blocks because they are not burnt. They are made by mixing silica or sand with chalk-lime in known proportions, and sufficient water to allow the mix to be moulded under pressure.

The resulting brick is subjected to steam for several hours, when hydrated calcium silicate is formed from the sand and lime by the action of the steam. Sand-lime bricks contain about 90 per cent. of sand. They are suitable only for internal work.

Glazed Bricks have glazed surfaces and may be used internally where cleanliness is essential, etc., but they are often used externally where a light-reflecting surface is required, as in the case of a light well, areas, etc.

Sizes.—Bricks will vary in size according to the district where they are manufactured. It is usually assumed that a brick is 9 in. long, 4½ in. wide, and 3 in. deep, but these sizes may vary from 8¾ in. to 9⅛ in. in length, from 4¼ in. to 4½ in. in breadth, and from 2⅝ in. to 3⅛ in. in depth. The width should be related to the length and should be constant.

Engineering bricks are usually full in size. The British Standard Specification for Bricks, No. 657, lays down the correct sizes of bricks, and most manufacturers conform to this specification. Architects may, however, require larger or thinner bricks for architectural reasons.

Weight will vary according to the material used and the size of the bricks, the following being approximate and given as a guide only :—

Flettons ..	6 lb.	Common ..	7 lb.
Stocks.. ..	7 lb.	Wire cuts ..	8 lb.
Engineering ..	9 lb.	Sand-lime ..	7 lb.

The weight of bricks will govern the rate of progress of the bricklayer; the heavier the bricks the slower will be the progress of the work.

Mortar

The chief types of mortar are cement mortar, lime mortar and gauged mortar. The choice of a suitable mortar depends on the bricks and the conditions of the structure to be erected.

Cement Mortar is made by mixing Portland cement and sand in definite proportions. This mortar is very strong and is suitable for hard bricks such as the engineering type.

The mortar should act as a cushion between the bricks, therefore if Portland cement mortar is used with soft or medium bricks there is liability of the bricks cracking should a slight settlement of the building occur.

Lime Mortar consists of lime and sand mixed in definite proportions. The lime should be grey stone lime if required for structural purposes. This type of mortar does not set as hard as cement mortar, and is therefore suitable for use with the softer variety of bricks.

Gauged Mortar consists of lime, Portland cement and sand, which are mixed in definite proportions. This combination produces the strength of a weak cement mortar and the pliability of the lime mortar.

Sand.—The sand for mortar should be sharp and free from clay or dirt, as described for concrete.

Mixes.—Cement mortar may be mixed in the proportion of 1 part of Portland cement to 1, 2, 3 or 4 parts of sand, according to the strength required. For normal type of work it is common to use 1 : 4.

Lime mortar may be in the proportion of 1 part of lime to 2 or 3 parts of sand.

Gauged mortar may be in the proportion of 1 part of lime to 4 parts sand and a small percentage of Portland cement added.

Pointing Brickwork

The joints of the brickwork may be either raked out while the mortar is "green," or pointed as the work

proceeds. The following are a few of the usual types of pointing :—

Weather Joint.—The joint is struck back from the lower edge of the bricks, giving a recess at the upper edge.

Struck Joint.—The joint is struck with the top flush with the face of the brickwork and the bottom projecting in front of the brick face.

Flush Joint.—The joint is flush with the brick face.

Ruled Joint.—The joint is flush with the brick face, but the centre of the joint has a rule passed along it to produce a small groove or V joint.

Internal walls which support structural loads may be built in 4½-in. or 9-in. brickwork complete with foundations as for the external walls. Other internal walls which are not intended to carry heavy loads may be constructed of 4½-in. brickwork and may be built directly on the surface concrete, but it is preferable to make the latter thicker in order to support the extra load occasioned by the wall itself.

A wall which intersects another should be bonded at least 2¼ in. into the cross wall, as in Fig. 25.

Walls which have to be built to a greater height than 5 ft. will require a scaffold for the bricklayer to stand upon and to support the walling materials during building operations. The scaffold may be erected in "lifts" of 5 ft., but this height will vary according to the height of the structure to be built. The most common form of scaffolding is steel tubular scaffolding; it is easily erected and adaptable to most forms of construction. This type of scaffolding is shown in Fig. 26.

Window Openings

Jambs.—It is usual to provide a reveal 4½ in. deep at the jambs in order that the window frame may be recessed and so help in preventing dampness penetrating into the interior of the building. Sometimes, however, window frames are placed in the opening near to the face of the wall. In such cases the jambs are formed without a recess and the frame is fixed against the face of the jamb.

The construction of jambs in relation to the brick bonding should be treated as in the case of a quoin and a closer inserted after the first header. This will bring the joints of the brickwork into the right relationship to each other. See Figs. 27, 28 and 29 for details of jambs and sills.

Head.—There are several ways of constructing the head over window openings. The weight to be carried by the head is equivalent to the weight of the material within an

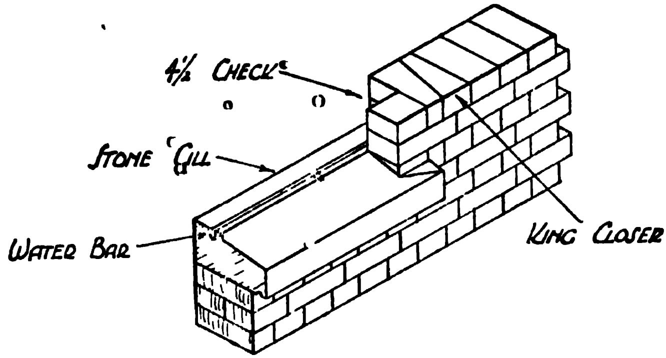


FIG 27. STONE WINDOW CILL

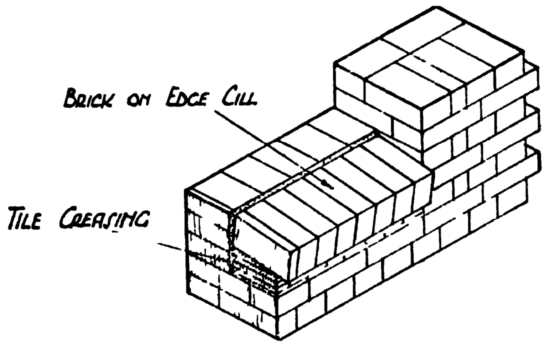


FIG 28 BRICK-ON-EDGE WINDOW CILL

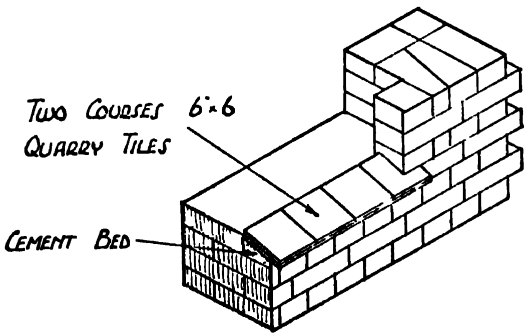


FIG.29 QUARRY TILE WINDOW CILL

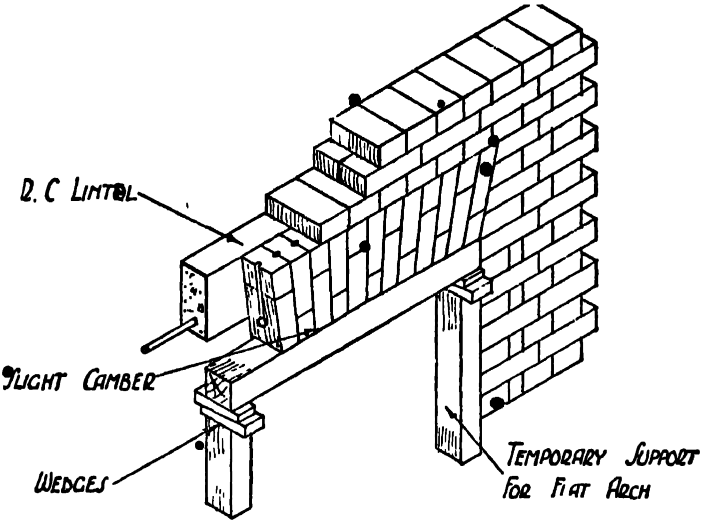


FIG 30 FLAT OR CAMBERED ARCH

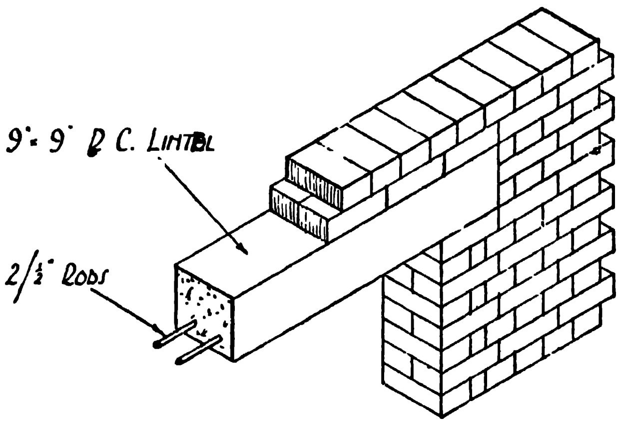


FIG. 31 REINFORCED CONCRETE LINTELS

equilateral triangle, for the full thickness of the wall, the sides of the triangle being equal in length to the width of the opening.

Brick arches may be either flat or segmental in form, according to taste and architectural treatment desired. A flat arch should be formed on a timber turning piece, which has a slightly cambered top surface and which is fixed in position so that the arch can be built upon it and constructed in such a manner that it can be removed at completion without injury to the arch, as in Fig. 30. A segmental arch will require to be supported on a timber centre during its construction.

Brick arches may be formed in one or more rings, according to the width of the opening and the load to be carried.

Reinforced Concrete Lintols

Reinforced concrete lintols intended to support the superimposed loads should be placed at the back of arches and they may be either pre-cast or cast *in situ.*

They should contain sufficient reinforcement to support the loads and resist the stresses occasioned by the loads. The reinforcement should be placed close to the bottom of the lintol.

Concrete lintols should have at least 6 in. bearing on the brick wall at each end as in Fig. 31.

Shuttering

For concrete lintols formed *in situ,* it is necessary to erect a system of shuttering or formwork sufficiently strong to carry the weight of the material forming the lintol. The brickwork or other walling material is built up to the top of the opening and to the underside of the lintol. Timber uprights are placed against the two jambs at the sides of the opening and strutted. The width of the opening may necessitate the use of intermediate uprights, in which case these would be strutted in conjunction with the side uprights.

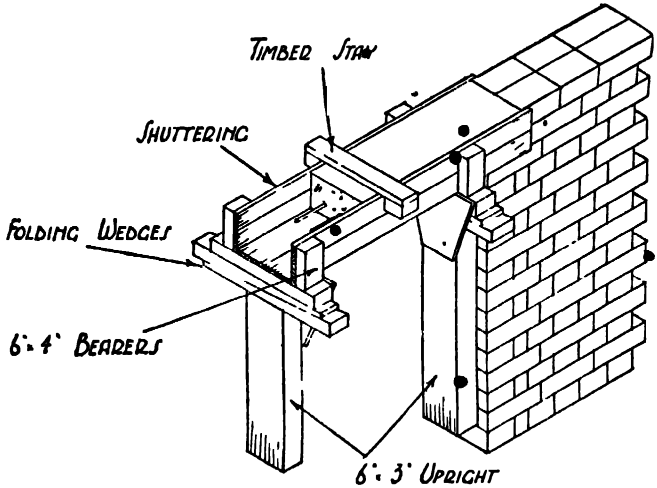


FIG 32 FORMWORK FOR INSITU LINTEL

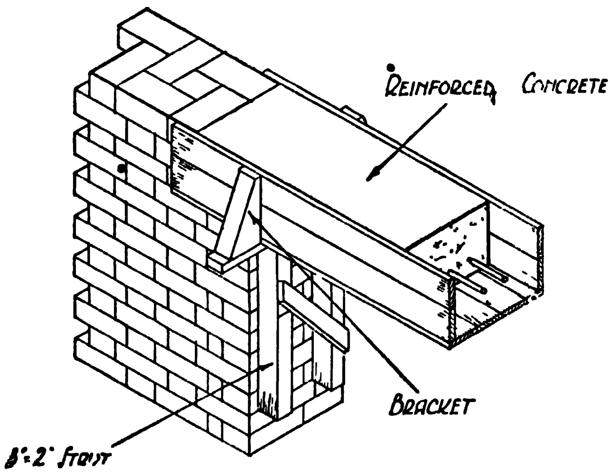


FIG 33 FORMWORK FOR INSITU LINTEL

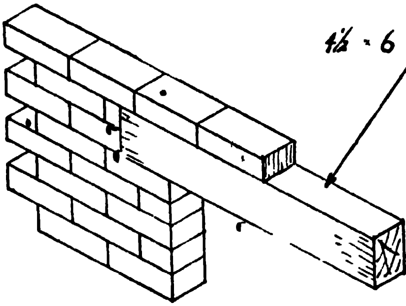


FIG. 34 TIMBER LINTEL

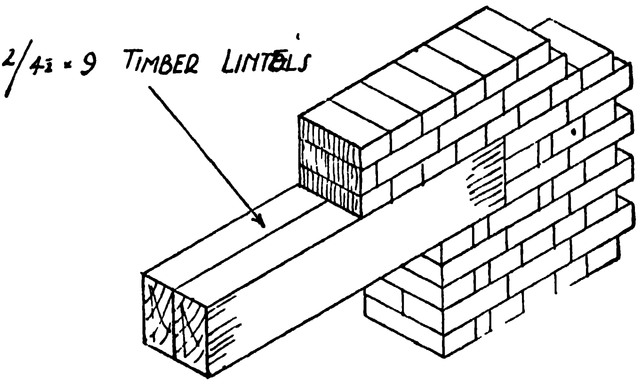


FIG. 35 TIMBER LINTEL

The boarding for the underside and two sides of the lintol should be framed together with cross timbers, the boards being square-edged. This framework is then placed across the opening and on top of the uprights in the correct position for the lintol. A pair of folding wedges should be placed in position at the foot or at the top of each upright, the wedges being tapped in until the whole of the lintol shuttering is secure and level, and at its correct height. The wedges are used to ensure ease in striking the shuttering, as in Figs. 32 and 33.

Reinforcement, if any, is placed and kept in position with wire until the concrete is placed.

In order to ensure that the sides of the shuttering do not bulge out, stays may be fixed at intervals across the top.

After the concrete has been placed and has set, the shuttering and supports may be removed by tapping and releasing the wedges.

Shuttering should be well wetted before concreting, as this will prevent the adhesion of the concrete to the surfaces of the timber.

Timber.—When timber lintols are used they must be sufficiently strong to carry the superimposed load. Any hard wood, such as oak, is preferable to deal. The construction of timber lintols is shown in Figs. 34 and 35.

Window Sills

The functions of a sill are to prevent the damp penetrating under the window frame and into the interior of the building, to provide a means of throwing off the rainwater and to prevent the rainwater running down the face of the brickwork immediately underneath the window opening. The means employed are : (1) The provision of a water bar set in a groove and bedded in red lead. The groove is cut in the top surface of the stone sill and also into the lower surface of the wood sill. (2) The formation of an inclined weathering on the top surface

of the sill and the provision of a drip and throat in the projecting portion of the sill. Sills may be constructed of stone, brick, tiles or similar materials. Stone sills should be provided with stoolings or horizontal seatings at their ends. Details of window sills are shown in Figs. 27–29.

Doors, External

Jambs to doorway openings are built in a similar manner as for window openings. They may be built without recesses for frames, in which case the brickwork should be bonded as for a stopped end.

During construction processes, fixing bricks should be built into the brickwork for securing the timber frame in position. It is common practice, especially in cheaper types of construction, to fix the door frames in position and build the brickwork around them.

Head.—The methods and materials as described for heads over window openings may also be applied to the construction of heads over door openings.

Threshold, also known as a sill, may be constructed in concrete, brick, stone, hardwood or any similar material which will resist abrasion.

Concrete thresholds may be finished with a Portland cement or granolithic screed to tread and riser.

Brick thresholds should be formed with bricks of a hard variety such as engineering bricks, etc., and laid on edge to give a rise of 4½ in.

Stone thresholds should be made from the durable types of stone such as York stone, granite or marble; the last-named may be in thin slabs as paving and bedded on a concrete core.

Wood thresholds should be in hardwood such as teak. Thresholds should be built in position at the same time as the surrounding brickwork, the top surface being slightly inclined or weathered.

Details of a stone and a brick threshold are given in Figs. 36 and 37.

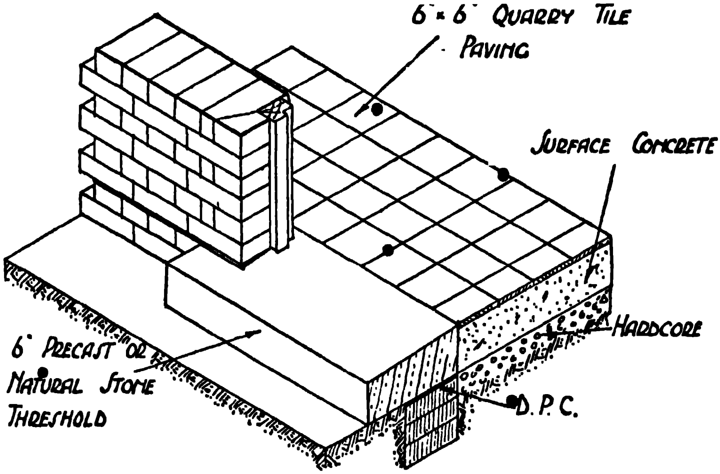


Fig. 36 Stone Threshold

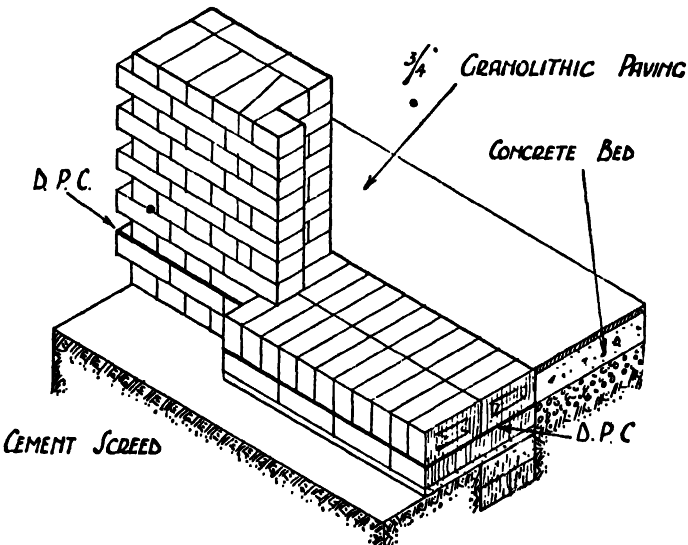


Fig 37 Brick-on-Edge Threshold

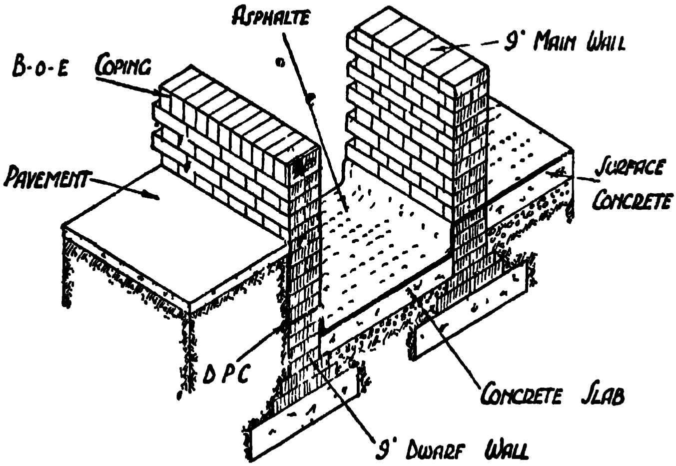


Fig 38 Dwarf Wall Surround to Open Area

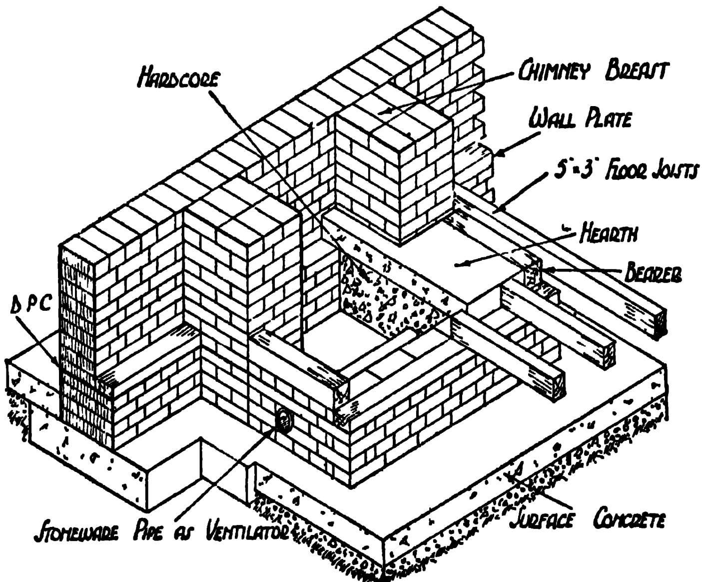


Fig 39 Fender Wall Around Fireplace Opening

Dwarf Walls

A wall may be termed a dwarf wall if under 5 ft. in height. Such walls may be used for sleeper or fender walls, yard walls, parapet walls, etc. The thickness of a dwarf wall will depend on the use for which it is built. A sleeper wall may be built on the surface concrete without extra foundations under it. A detail showing the construction of a dwarf wall surround to an open area is shown in Fig. 38.

Fireplaces are formed by building out attached piers from the internal face of a wall to accommodate the fireplaces. The attached piers are termed jambs.

Fireplaces can be arranged as single projections or placed back to back or across one of the angles of a room.

Before constructing fireplaces, chimney breasts and stacks, reference should be made to local building bylaws, which will be found to regulate the construction of chimneys, etc.

The base of the jambs should be treated in the same manner as for ordinary walls with regard to footings, concrete, foundations, etc.

The minimum width of the jambs should be 9 in., but they are usually constructed 13½ in. wide. The width of the jambs will depend very largely upon the position of the fireplace in the building, because if it is to be built in association with a multiple-storey building, the flues for the lower floors will have to be accommodated within the jambs of the fireplaces in the floors above.

The jambs are usually constructed the same width on either side of the fireplace opening, for symmetry.

The brickwork above the fireplace opening is called the chimney breast, and as the various flues from the fireplaces, situated on the lower floors, have to be accommodated in the chimney breast, it may be necessary to widen the overall size of the breast of the upper fireplaces. This may be done by corbelling the brickwork in easy stages on either side of the fireplace opening until the required width is

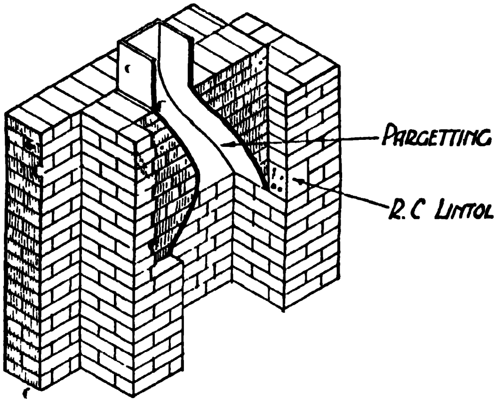


FIG 40 GATHERING OF FLUE OVER FIREPLACE

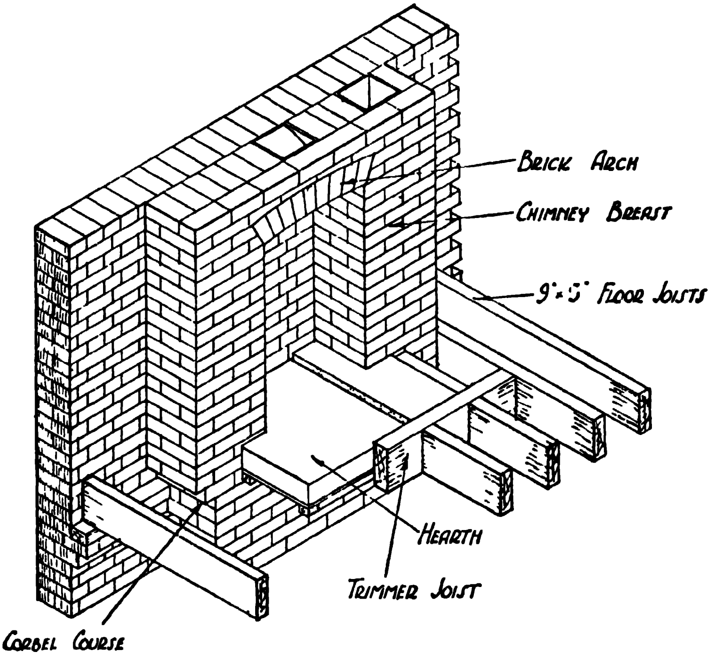


FIG 41 FIREPLACE ON UPPER FLOOR

obtained. Such corbelling should be arranged to come between the floor thickness.

Hearths may be constructed of brick, stone, concrete, tiles or any similar fire-resisting material. They should be at least 6 in. wider either side than the fireplace opening, and 1 ft. 6 in. from the face of the jambs and continued to the back of the fireplace opening.

Ground Floor Hearths may be laid on a filling of hardcore which has been well consolidated and levelled. A fender wall should be built up from the surface concrete to support the front of the hearth and the ends of the floor joists situated in front of the fireplace opening. The construction of a fireplace opening at ground floor level is shown in Figs. 39 and 40.

Upper Floor Hearths require a different method of construction. In this case it is necessary to cantilever the hearth to 18 in. from the face of the jambs.

There are one or two ways in which this can be done. Firstly, if the hearth is to be formed in concrete, then by shuttering the underside of the space between the trimming joists and the trimmer, a concrete slab can be formed on the shuttering. The top surface of the concrete is finished 1 in. below the level of the floor to allow for a layer of tiles to form the hearth finish. The shuttering need not be removed. See Fig. 41.

With the use of pre-cast concrete, the slab may be built in as the brickwork is erected. The older method of construction, however, is to form a trimmer arch, which consists of a half-brick rough arch built out from the face of the chimney breast and supported against the trimmer, and forms the base for the concrete hearth. Reference should be made to the notes on " trimming " joists around fireplaces, page 79.

Fireplace openings may be covered in various ways providing fire-resisting material only is used for this purpose. Concrete lintols, whether cast *in situ* or pre-cast, may be used. In the former case the brickwork is built up

to the lintol height, the shuttering is erected, and when the steel reinforcement has been placed in position the lintol is cast. When the concrete is set, the brickwork is built on it. If the lintol is pre-cast, it may be built in as a unit at the same time as the brickwork is being erected.

Brick arches, formed in two brick rings, are often constructed over fireplace openings, and if the chimney jambs at the sides of the fireplace opening are less than 13½ in. wide, the brick arch should be supported on an iron chimney bar. Chimney bars consist of a flat bar, each end of which is built into the brickwork, the bar carrying the brickwork above the opening in the same manner as a lintol. The size of the fireplace opening will be determined by the type of grate to be fitted.

Fender Wall

Where a fireplace is situated on a ground floor it is necessary to keep the timber joists and all such non-fire-resisting material away from the fireplace.

In order to do this it is necessary to provide support for the ends of the joists in front of the hearth; this support is provided by the fender wall, as already stated.

The wall is built up from the concrete surface layer and is usually 9 in. thick. It is built in front of the fireplace opening so that the centre of the fender wall is 18 in. from the face of the jambs. The ends of the joists will rest 4½ in. on the fender wall, as shown in Fig. 39.

Chimney Breasts and Stacks

The brickwork above the fireplace opening is called the chimney breast, while the brickwork above the roof is called the chimney stack. The flues are contained in the breasts and stack. The normal size of flues is 9 in. × 9 in., the walls of which should be at least 4½ in. thick. Each fireplace should have its own flue to the full height of the chimney stack. An almost straight flue is the most efficient, but it is not usually practicable in construction to

form such a flue, as other fireplaces on the various floors have to be avoided, and this will cause the flue to turn in its upward course.

The method of turning the direction of the flue is by corbelling the brickwork. When the flue leaves the fireplace opening it must be gathered over until the required size of the flue is obtained, and again, as in turning, this is done by corbelling the brickwork, as shown in Fig. 40.

Upon reaching the roof the flues are made to converge so as to rise symmetrically within the chimney stack.

The internal surfaces of flues should be rendered so that all crevices, etc., will be filled in, and the roughness of the projecting brickwork, due to corbelling, made smooth so as to allow easy passage for the smoke and sooty particles.

The materials used may be Portland cement and sand rendering, trowelled smooth, or lime mortar with the addition of cow dung. The process of lining flues is termed parging or pargetting.

Sometimes a fireclay flue lining is incorporated while the brickwork is being erected.

Flues must be kept free from mortar droppings, etc., during building operations, as such droppings may cause the flue to be blocked up. This may be prevented by placing a sack in the flue as building operations are proceeding and by drawing the sack up as the flues are built so as to catch the droppings. Flues are parged as the brickwork is built.

The reduction of the width of the chimney breast to the width of the chimney stack as it passes through the roof is accomplished by setting back the bricks in each course within the roof space until the required width is obtained.

Chimney stacks are often built with 9-in. walls, but 4½-in. walls may be used. The height of a chimney stack should be at least 3 ft. above the highest point of the roof adjacent to it, so as to avoid any tendency to down draughts.

Flues are usually terminated by a chimney-pot which should be securely embedded in brickwork and set in

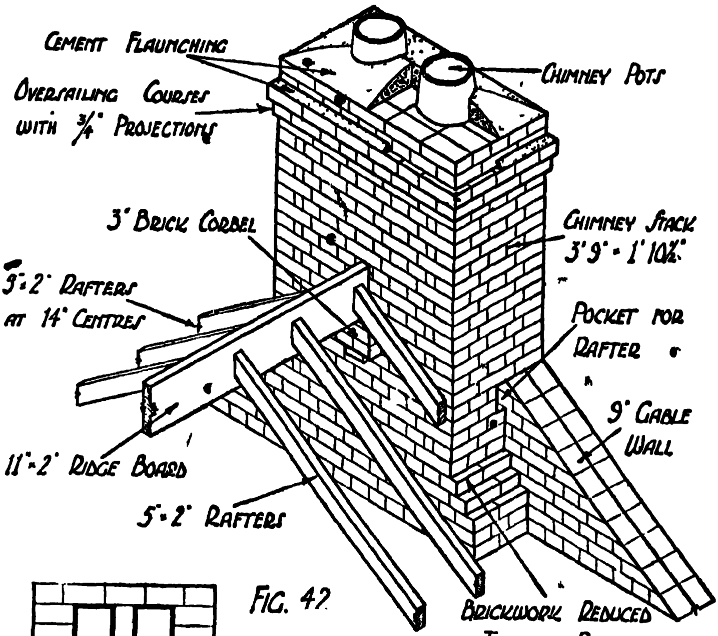


FIG. 42

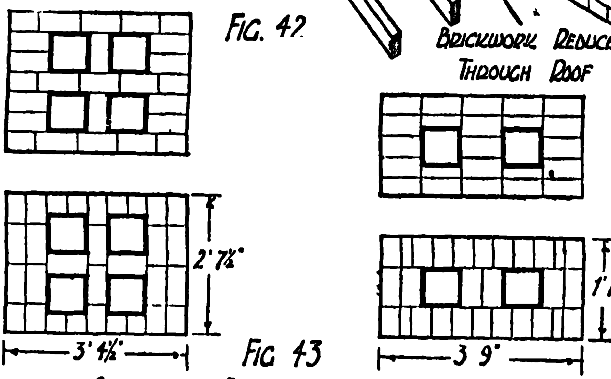


FIG 43

ALTERNATE BONDING COURSES OF BRICKWORK FOR TWO AND FOUR FLUE STACKS

Portland cement mortar, the latter being flaunched round the pot. The brickwork at the back of the chimney opening must be at least 9 in. thick up to a height of 12 in.

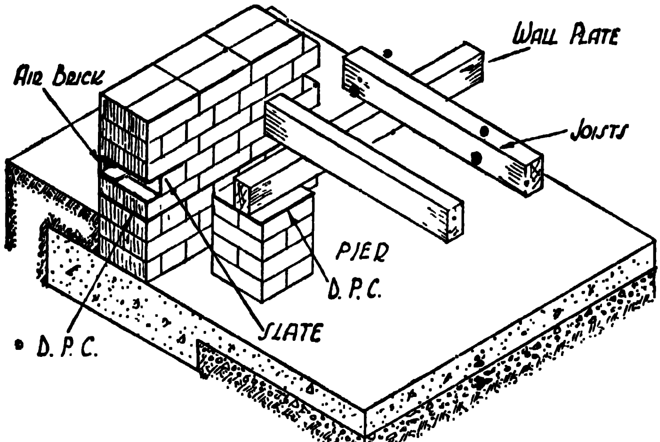


FIG. 44 GROUND FLOOR CONSTRUCTION - PIER SUPPORT

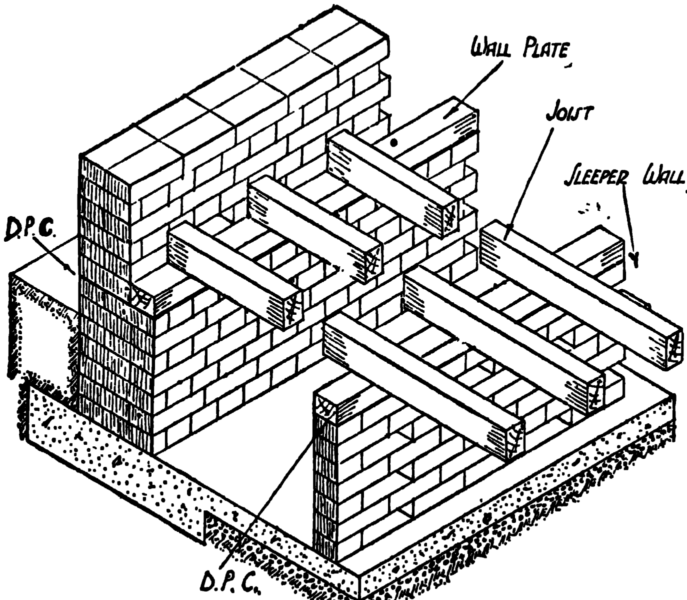


FIG. 45 GROUND FLOOR CONSTRUCTION - SLEEPER WALLS

above the lintol over the fireplace opening. Construction of chimney stack is shown in Figs. 42 and 43.

Construction at Ground Level

Sleeper Walls.—When the ground floor is the lowest floor of a building the joists are often supported by sleeper walls at one or two points in their length.

Dwarf walls from 18 in. to 3 ft. high, according to the height of the floor above the surface concrete, are built of 4½-in. brickwork in stretcher bond. A timber wall plate is bedded on the top of the wall, and upon this the joists rest.

For the purpose of providing through ventilation of the space under the floor, bricks are omitted in the length of the wall at intervals. The external walls should have air-bricks built in them just below floor level so that a current of air is allowed to pass through the wall and under the floor, thereby preventing the joists from being attacked by dry rot.

The provision of a damp-proof course on the top surface of sleeper walls and under the wall plate will prevent dampness from the surface concrete reaching the floor joists.

The end of the ground floor joists may be supported on a 4½-in. sleeper wall built up from the surface concrete and close to the external wall, or the end of the joists may be supported on 9-in. brick piers, built at intervals over the floor area, as shown in Fig. 44. The best method, however, is to project the walls of the building at their base to form a seating for the timber wall plate, as shown in Fig. 45.

Construction at Upper Floor Level

The floor joists of an upper floor may be supported on a partition wall or on a cross wall, as in Fig. 46, in which case a wall plate is bedded on the wall to carry the joists and distribute the loads from the floor equally over the whole length of the wall.

Where a cross wall is to be continued higher than the floor to form a partition for the rooms above, the floor

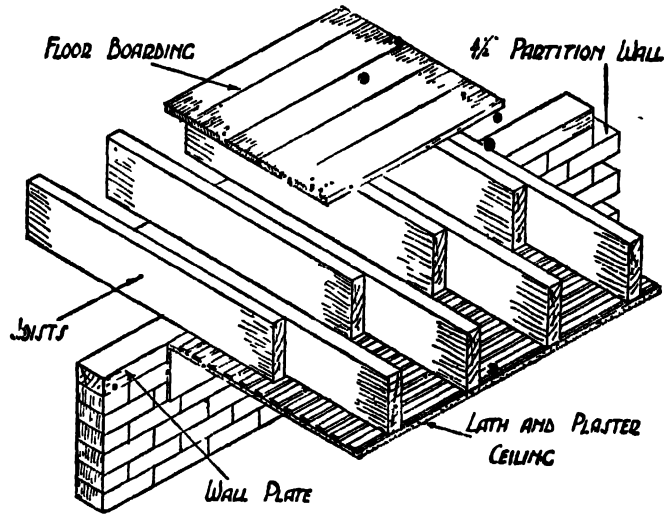


FIG. 46 CONSTRUCTION AT UPPER FLOOR - PARTITION WALL

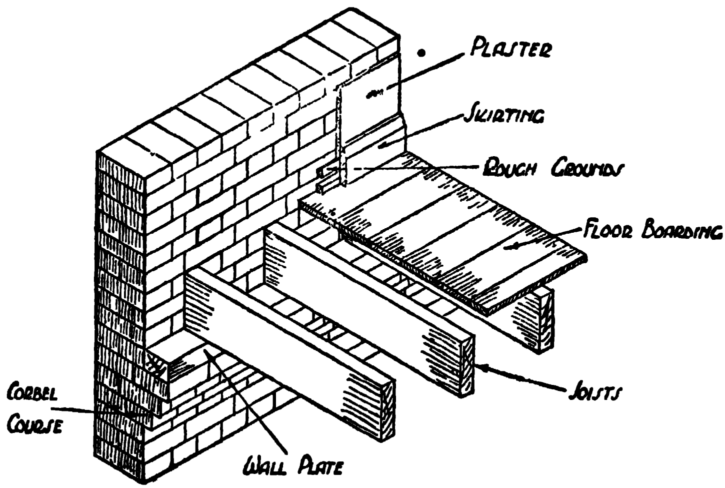


FIG. 47 CONSTRUCTION AT UPPER FLOOR - CORBEL COURSE

joists may be supported on a wall plate which rests upon steel brackets cantilevered out from the wall face.

Alternatively, the brickwork may be corbelled out from the face of the wall for a distance of 4½ in., upon which a 4 in. × 3 in. timber wall plate can be bedded for the support of the ends of the timber joists, as shown in Fig. 47.

Where steel floor beams are used in the floor construction, the brick walls supporting the beam may have to be increased in thickness. This may be done by building an attached pier immediately under the point of support.

The pier should have a concrete or stone padstone placed directly under the steel beam.

This same construction will also apply when steel roof trusses have to be supported on brick walls.

With reinforced concrete floors, however, it is usual to form a horizontal chase in the brickwork to receive the floor slab. The depth of the chase varies from 2¼ in. to 4½ in., and its height will correspond with the thickness of the floor slab. The chase will form the wall support for the concrete floor slab.

It may be possible to reduce the thickness of the external walls at floor levels, providing they are of sufficient thickness to carry the loads to which they are liable to be subjected.

Local regulations must be consulted before any reduction in thickness is made.

Construction at Roof Levels

The brickwork at the eaves of a pitched roof is usually carried up to the underside of the rafters and then surmounted by a timber wall plate which is intended to provide support for the feet of the rafters, and distribute the roof load equally over the wall.

The wall plate may be bedded on the wall close to the internal face of the wall or along the centre of it.

Where roof trusses, or roof beams, are to be supported,

the wall may be increased in thickness to secure stability, and the brickwork may be cut and fitted around the structural members.

A good reason for building up the brickwork under the eaves and close up to the roof covering is to prevent draughts and damp entering the roof space.

The eaves may be boxed-up with soffit and fascia boarding, thus ensuring almost complete insulation at the junction of the wall and roof, as in Fig. 48.

When the brickwork is carried up to the underside of the rafters, the bricks are chamfered to form a fairly close joint between the underside of the roofing material and the wall, as shown in Fig. 49.

Partition walls are usually finished off at ceiling level and surmounted by a timber wall plate to give support to the ceiling joists.

Gable walls may be carried up beyond the roof surface, and capped with a stone coping, or they may finish immediately under the inclined roof surface.

In the latter case the roof covering continues over the top of the wall and projects beyond the face of the wall. The roof finish is then termed a verge.

Construction at Parapets

Parapet walls may be formed in conjunction with either flat or sloping roofs. In the case of a flat roof the brickwork is continued above the level of the roof, the height varying according to requirements.

The brickwork may be reduced in thickness at the levels mentioned by setting back the brickwork 4½ in. on the inside face, and this setback will provide a seating for floor timbers, etc. The thickness of brickwork for parapets is usually 9 in.

The top of the parapet wall must be finished off with a capping, or a method of construction must be adopted which will seal the top of the wall and prevent rainwater from soaking into the wall. This may be accomplished by

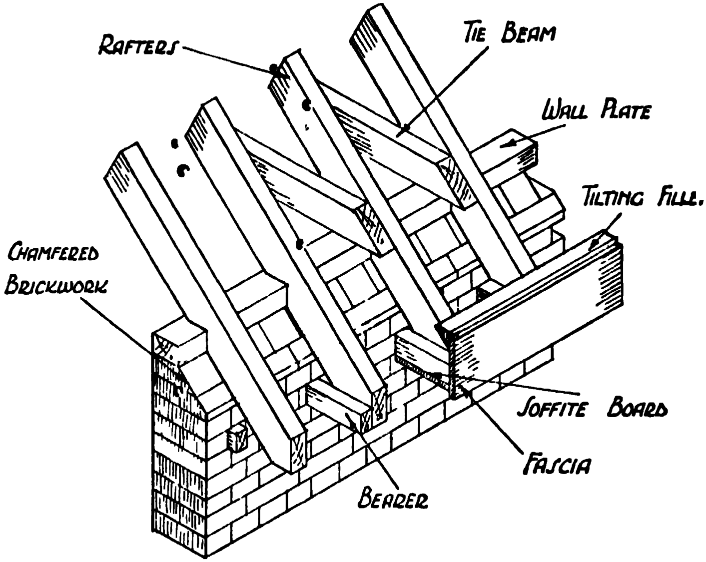


FIG 48 PITCHED ROOF – EAVES CONSTRUCTION

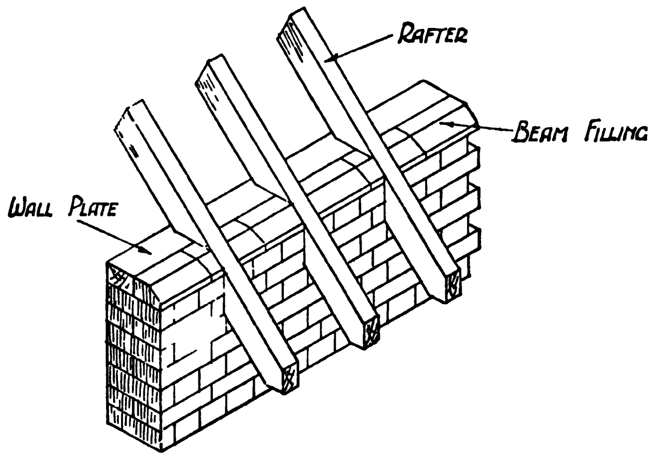


FIG. 49 PITCHED ROOF – BEAMFILLING AT EAVES.

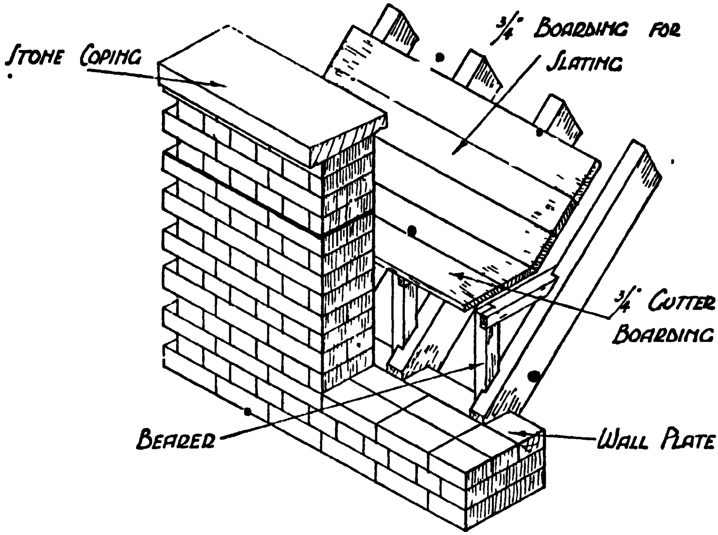


FIG. 50 PARAPET WALL TO SLOPING ROOF

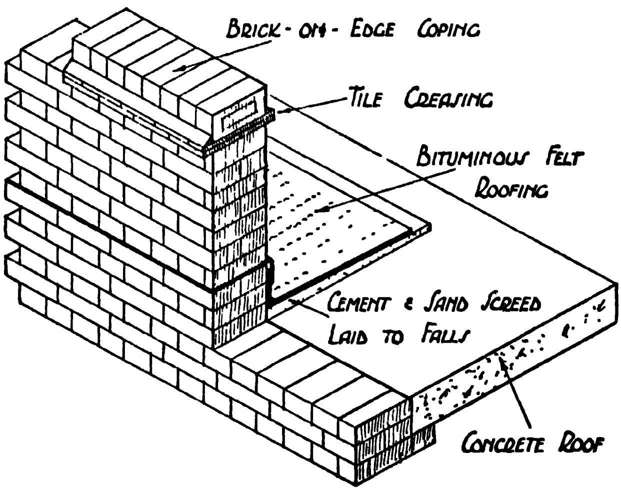


FIG 51 PARAPET WALL TO FLAT ROOF

providing a course of coping made of stone, brick, pre-cast concrete or similar material, bedded and jointed in cement mortar on the top surface of the wall.

The coping should project on either side of the wall for about 2 in., be throated on both sides and weathered towards the internal face of the brickwork.

The purpose of weathering and throating is to prevent the rainwater running down the faces of the brickwork, with the possibility of moisture soaking into it and making the walls of the upper rooms damp. Details of parapet walls are given in Figs. 50 and 51.

CHAPTER IV

CAVITY WALLS

Method of Construction

A cavity in a wall is usually formed to prevent the penetration of damp into the building, either in the form of rain soaking through the external walls or by the infiltration of damp from the atmosphere.

A cavity may also be formed expressly to insulate the interior of buildings from changes of temperature.

Cavity walls are constructed by forming two skins, either comprising two half-bricks, as in Fig. 52, or a combination of one half-brick and one brick, as in Fig. 53. The latter may be built with the half-brick skin as the internal or external part of the wall, according to opinion and structural requirements.

Stretcher bond is commonly used for walls with a half-brick external skin, but Flemish bond appearance can be obtained by using snap headers where headers are required in the bond. Care must be taken that mortar droppings, etc., are not allowed to fill the cavity, as this will permit moisture to cross the cavity and contact the inner skin. To prevent the droppings, etc., filling the cavity, a strip of wood about 2 in. wide may be placed in the cavity and raised as the brickwork rises.

Bricks may be left out at intervals in the bottom inside course of a cavity wall in order that rubbish which has inadvertently been allowed to fall may be cleared, these spaces being filled when the wall is erected and sealed.

Base of Cavity Walls

The construction of the brickwork at the base of cavity walls is the same as for solid walls, the wall being built with or without footings, according to the requirements of the local authorities. Should the cavity wall be formed

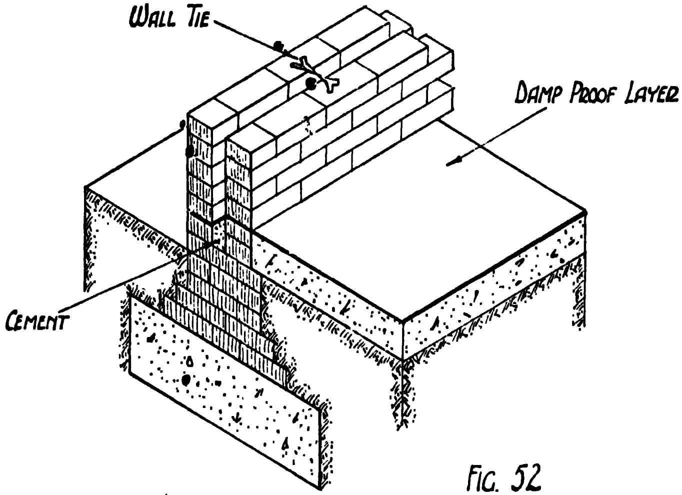


FIG. 52

CAVITY WALL - BASE OF TWO HALF BRICK SKINS

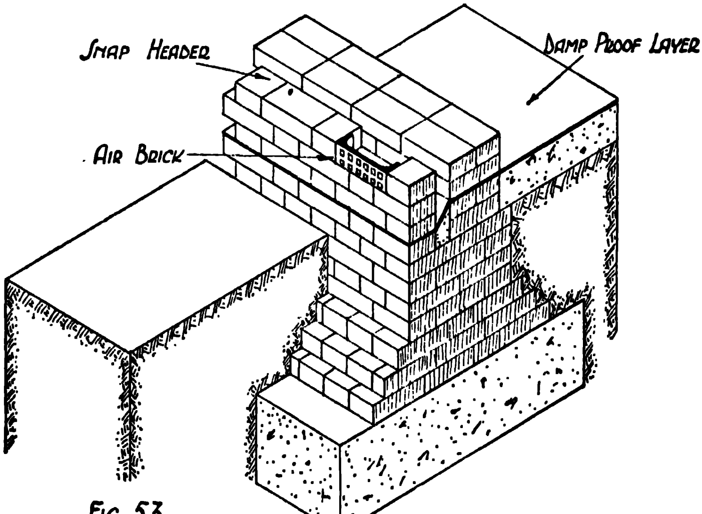


FIG. 53

CAVITY WALL - BASE OF ONE & HALF BRICK SKINS

of two half-brick skins with a 2¼-in. cavity between them, the width of the solid brickwork to the footings will be 13½ in., and this will allow a 2¼-in. setback at floor level for the support of joists or surface concrete, as in Fig. 52. If footings are used the construction is the same as previously set out for solid walls, the brickwork being built up to the damp-proof course level, at which point the wall is set back and built in two skins.

There is no purpose in building the portion of the wall below ground level in two skins as the damp-proof course may be placed so that it will prevent the damp penetrating into the building; also the increased thickness of the wall will assist in supporting the load to be carried.

Damp-proof Courses

As in solid wall construction, the provision of a damp-proof course is essential in cavity wall construction. Any of the materials detailed previously may be employed, but the best kind for this type of wall construction is either bituminous felt or asphalte, the reason for this being that a continuous damp-proof course can be formed throughout the thickness of the wall. When the surface concrete is situated above the ground level the damp-proof course can be carried through the outer and inner skins of the wall, across the base of the cavity and then in a continuous layer across the surface concrete, thus forming a surface damp-proof layer, as in Fig. 54.

When foundations are formed in conjunction with a surface concrete layer which is situated below ground level, the damp-proof course may be carried through the outer skin of the wall at a position 6 in. above ground level and then continued down the inner face of the outer skin until it reaches a convenient point below the ground level. It should then be carried through the inner skin at the level of the surface concrete and continued across the surface concrete layer, as described previously. The construction of the base of a cavity wall in conjunction with a basement

and the method of damp-proofing are shown in the diagram, Fig. 55.

Construction at Floor Levels

The cavity commencing 6 in. above ground level will in many cases be approximately at the same level as the bottom of the surface concrete slab, therefore the solid brick foundations may be constructed $2\frac{1}{4}$ in. beyond the inner face of the cavity wall. This projection will provide a seating for the edge of the surface concrete, as in Fig. 54.

If a timber-joisted floor is to be constructed it is advisable to build up a $4\frac{1}{2}$-in. wall independent of, but close to, the cavity wall to support the ends of the floor joists, as in Fig. 56.

The floor joists for upper floors may be carried on the inner skin by bedding a wall plate on the $4\frac{1}{2}$-in. inner wall and allowing the ends of the joists to rest on the wall plate. The ends of the joists, however, should not extend across the cavity. A piece of 3 in. × $\frac{3}{4}$ in. flat steel may be used in preference to a timber wall plate. If the load to be carried is too great for a $4\frac{1}{2}$-in. wall, a 9-in. inner wall should be constructed, as shown in Fig. 57.

Window Openings

The most vulnerable points in the construction of cavity walls are the window and door openings, as it is at these points that the dampness may cross the cavity and the value and benefit of the cavity become nullified.

Jambs.—There are several methods of constructing the jambs. The cavity at the sides of the opening may be built in solid with brickwork, either by filling the cavity with bricks or by bonding with bricks in the same manner as for a solid jamb, as shown in Fig. 58.

Another method of sealing the cavity is by filling the cavity with vertical layers of tiles or slates bedded in mortar, as shown in Fig. 59.

Slates and tiles, being almost impervious to moisture, will not allow the penetration of damp from the outside

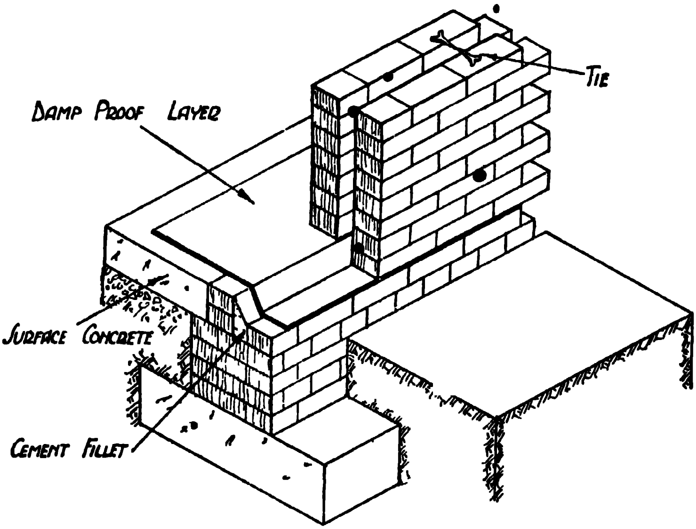


Fig 54 Damp Proof Course in Cavity Wall

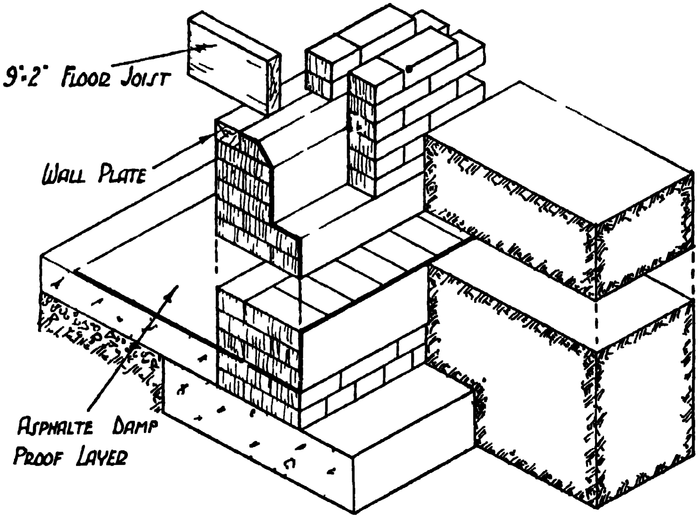


Fig 55 Damp Proof Course in Basement & Cavity Wall

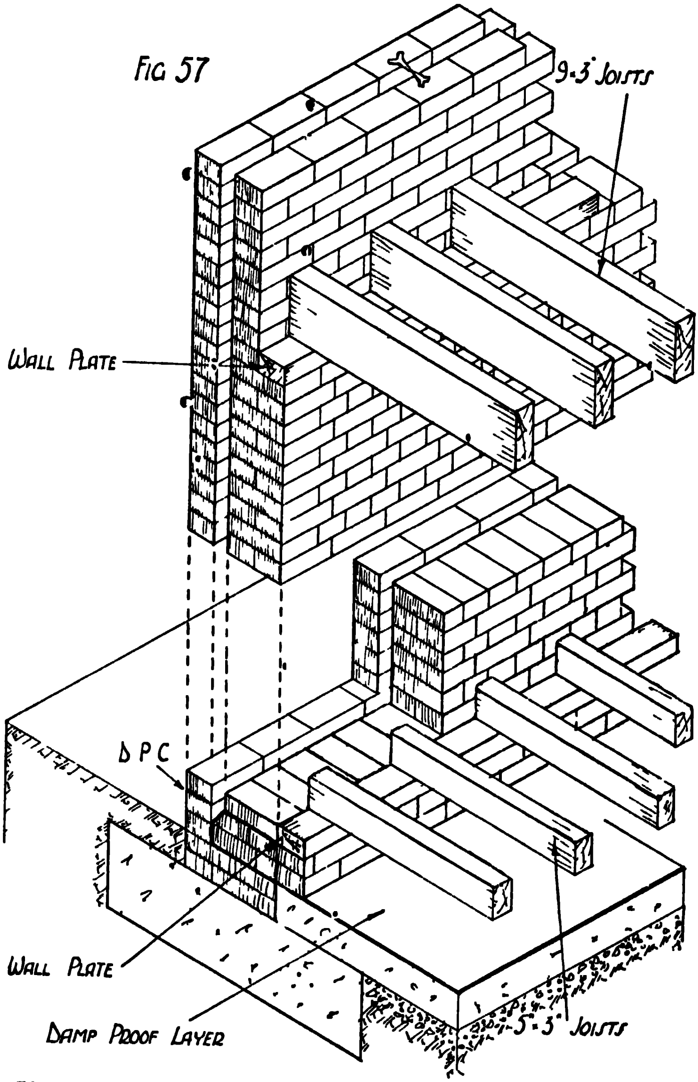


Fig. 56 Cavity Wall - Floor Construction

under normal circumstances, but there is always the liability of dampness creeping round the surface of the tiles or slates and thus contacting the inner wall.

When metal frames are to be used, these can be obtained specially made for fixing in cavity walls. These make a very good seal against dampness.

Head.—The brickwork above the head of an opening should be supported on a reinforced concrete lintol, brick arch or, if desired, any other similar form of construction. The width of the lintol, being the same as the width of the inner wall, will allow the cavity to continue over the opening.

It may be that a concrete lintol can be used on the inside whilst a brick arch or stone head may form the facing on the outer skin. In such a case the cavity space may be covered by the wood frame and, if so desired, the concrete lintol resting on the inner skin may be raised a course of brickwork to allow the frame to set in a rebate, as in Fig. 60.

The lintol or arch will need flashing, and this should be carried through the outer skin and across the cavity, where it is built in the wall for a distance of at least 3 in. The flashing material above the arch or head should be allowed to project beyond the face of the wall so as to form a drip to throw the rainwater clear of the opening, as in Fig. 61.

Sill.—If possible, the cavity should be continued up to the sill of the frame. This procedure will mean that the cavity will extend up the back surface of the stone sill, the cavity being bridged by the wood frame.

Should metal window frames be fitted, the same type of construction will apply as mentioned for jambs. The metal sill will fit over the rebate in the weathering of the sill and down to the window board on the inside of the opening.

Where tile sills are used, the tiles are bedded in a sloping position on the outer skin of the wall, the wood frame being grooved on the underside to receive the nib on the tile, as in Fig. 58.

In such cases the wood sill should be bedded on a layer

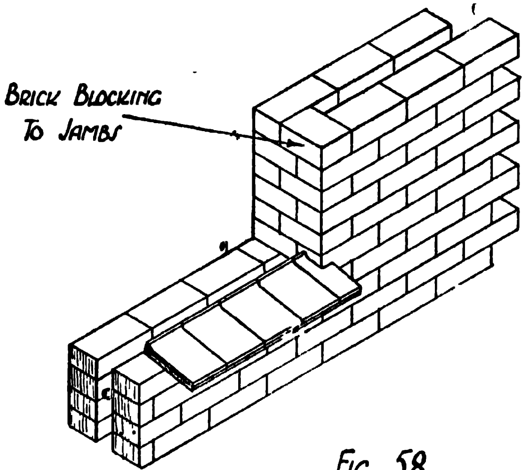


Fig. 58

Cavity Walls - Window Opening

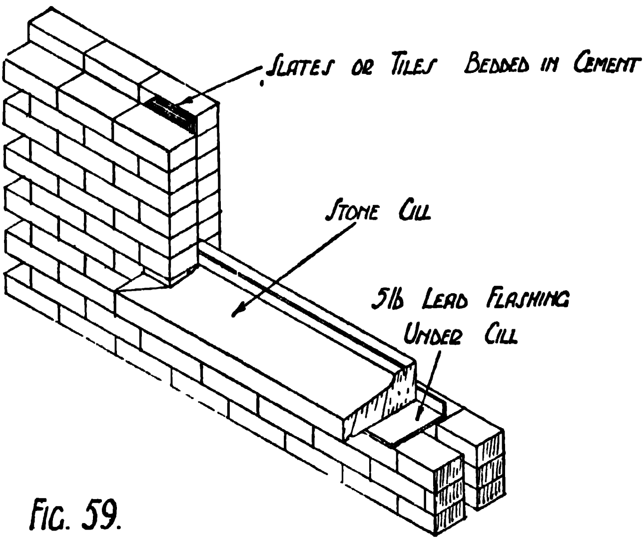


Fig. 59.

Cavity Walls - Window Opening

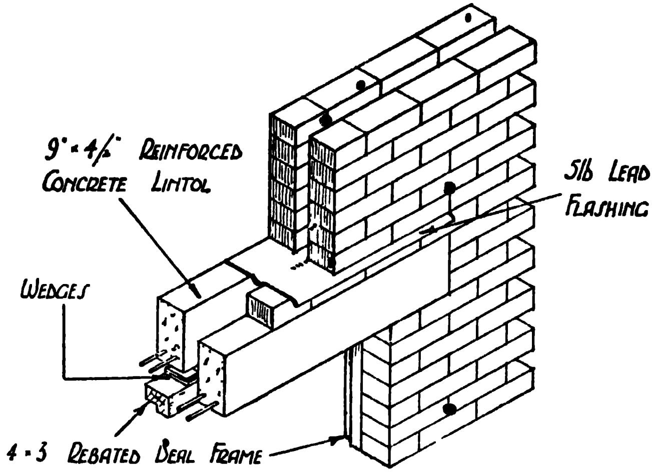


Fig 60 Cavity Wall - Concrete Head to Opening

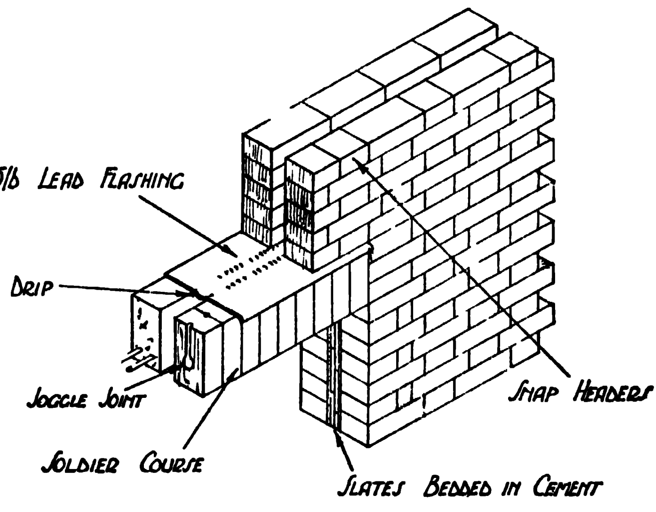


Fig. 61 Cavity Wall - Brick Head to Opening

of mortar so as to fill the spaces between the tiles and the underside of the wood sill. Should it be required to have a solid stone or brick sill bridging the cavity, the sill should be bedded on sheet lead, the lead being turned up at the back of the sill and allowed to project in front of the outer face so as to form a drip, as in Fig. 59.

Door Openings

The methods described for sealing the cavity around window openings will apply to the sealing of the cavity around door openings.

Jambs.—The bonding of the door jambs in cavity walls is carried out in a manner similar to the construction at window openings in cavity walls. Protection against the infiltration of dampness between the brickwork and the wood frame will be afforded if the frame is fixed in a rebate.

Head.—The construction at the head of an opening in a cavity wall is similar to that described for the heads over window openings in cavity walls. In each case the cavity should be continuous over the opening and a flashing formed so that any moisture which may accumulate in the cavity over the opening is discharged into the cavity at the sides of the opening, as shown in Figs. 60 and 61.

Threshold.—Normally, external door openings will be situated at ground floor level and where the cavity wall construction commences. The threshold will therefore be bedded on the solid brick wall and dampness excluded from the inside of the building by the provision of an efficient damp-proof course, as shown in Fig. 37.

Wall Ties

The two skins of brickwork comprising a cavity wall would be structurally unsound if they were not tied together. The method usually employed is to connect the two skins by inserting wall ties at intervals across the cavity. The ties should be made of metal which will not rust or be

affected by corrosion, the most common metal used for this purpose being galvanised iron or copper. The ties are made about 8 in. long with the ends split for building into the brick skins, and they are twisted at their centre so that any moisture which may accumulate on the surface of the ties will not cross the cavity but will be discharged clear of the inner skin. A detail of a metal tie is shown in Fig. 62.

The ties are spaced about 3-ft. centres horizontally and about 12 in. vertically, and they should be staggered throughout the height of the wall in order that the moisture from one wall tie will not drop on the tie below.

Specially formed brick ties are sometimes used to connect the two skins.

Ventilation

The adequate ventilation of cavity walls is an important factor in the success of their construction because it is essential, if best results are to be obtained, that a free current of air should circulate throughout the cavity. The purpose of this is to prevent the imprisonment of stale air in the cavity which would probably cause dampness and the harbouring of germs and vermin, thereby nullifying the advantage of cavity wall construction.

The disadvantage of the ventilated cavity wall is that cold external air will also circulate through the cavity, tending to make the building cold. By sealing the cavity the building will not be subject to the same heat loss.

The provision of a current of air in the cavity is even more essential should timber floor joists, wall plates, etc., be built into the wall so as to ensure that the woodwork is exposed to the air in the cavity, thus preventing the timber being attacked by dry rot.

The air is brought into the cavity through the medium of air bricks, which are built into the outer wall in positions as near as possible to its base and the highest part of the cavity, as shown in Fig. 53.

Air bricks are usually made in brick sizes, namely,

9 in. × $4\frac{1}{2}$ in. × 3 in. high, but units of larger dimension are often used. Sketches of air bricks are given in Figs. 63 and 64.

Construction at Eaves

When cavity walls are built in association with sloping roofs, the cavity should be closed just below the eaves. To do this the cavity may be bricked over and the top few courses of bricks built in solid brickwork.

It is essential that dampness shall not collect on the solid brickwork and so penetrate to the inner skin of the cavity wall below, as under such conditions the effectiveness of the construction will be reduced. In order to prevent this, a damp-proof course should be built the whole width of the wall at the top of the cavity.

If the eaves project beyond the face of the wall this will provide a certain amount of protection from rain and damp. The provision of a fascia and soffit board, as in the case of boxed-up eaves, will assist in keeping the top of the wall in a dry condition.

Where gable walls occur, the cavity should be continued up the gable brickwork until it is within about two courses of the top. These two courses may be built solid and a damp-proof course incorporated as before described. The solid brickwork will be protected from the weather by the fixing of a barge board on to the gable end should the roofing project beyond the gable wall.

When a roof is to be carried on roof trusses, the weight of the roof will be concentrated on the wall in the form of point loads. Such point loads are usually too great to be carried by the inner skin of the cavity wall, and it then becomes necessary to provide extra thickness of brickwork by building attached piers out from the wall face. These piers will assist in transmitting the roof loads to the foundations. The building of such piers will form part of the construction of the inner skin and will be an integral part of it, therefore they must be bonded with the wall in a

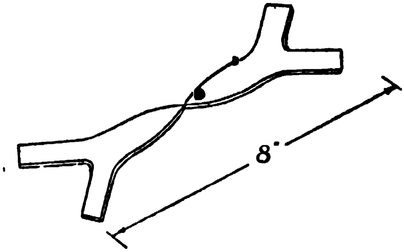


FIG 62 GALVANISED IRON WALL TIE

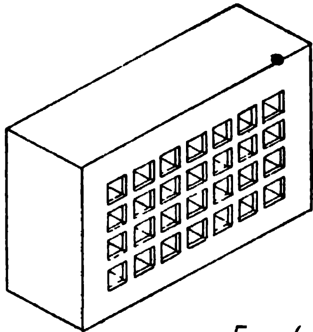


FIG 63
TERRACOTTA VENTILATING AIR BRICK

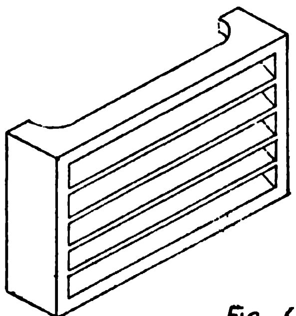


FIG 64
CAST IRON VENTILATING AIR BRICK

suitable manner. A padstone or template should be provided at the top of the pier and through the inner skin to form a seating for the roof truss and to assist in distributing the loads over a greater area of the wall. The pier should be continuous down to the concrete foundations, and these must be widened so that the load per square

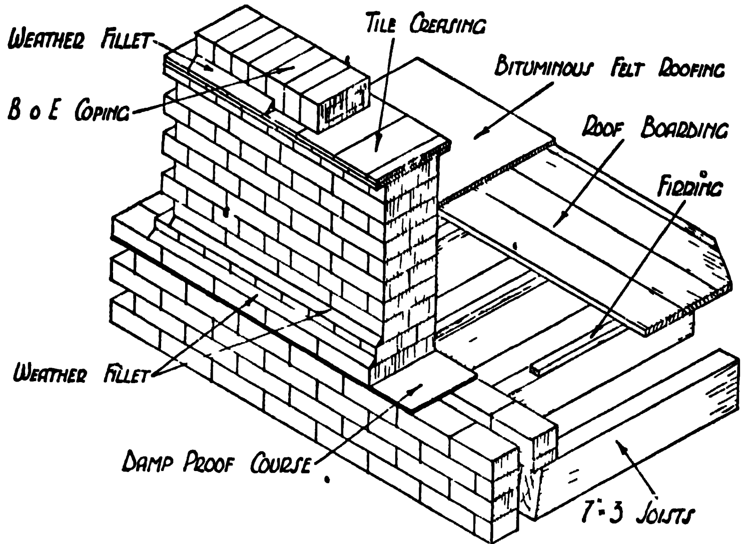


FIG. 65 CAVITY WALLS – PARAPET WALL

foot will not exceed the safe bearing capacity of the soil per square foot.

Construction at Parapets

These notes will deal with the flat roof type of construction, or pitched roofs which are set back from the main wall face and terminate at the back of a parapet wall.

Since a parapet wall is a continuation of the main wall, the cavity may be closed at the base of the parapet wall, or it may be continued up almost to the full height of the parapet.

In closing the cavity, a damp-proof course should be

formed across the full thickness of the wall, while the face line of the solid portion of the parapet wall, above the D.P.C., is set back to cover the cavity. The wall may be finished off with a brick-on-edge or stone coping.

To provide for extra insulation from dampness, a damp-proof course may be laid immediately under the coping and extend the full width of the parapet wall The construction of a parapet wall over a cavity is shown in Fig. 65.

When the cavity extends higher than the level of the parapet gutter, a damp-proof course may be placed in such a position that it will extend through the inner skin of the wall and be turned down the face of the wall to form the cover flashing to the gutter covering. This arrangement will also assist in preventing the damp penetrating through the inner skin to the rooms below.

CHAPTER V

FLOOR CONSTRUCTION

Ground Floors on Solid Concrete

Should it be desired to form a floor close to the surface concrete layer it will be advisable to lay the floor boards on wood battens arranged about 12 in. apart and connected to the concrete floor slab. The concrete surface layer should have a damp-proofing layer situated within its thickness, or the top surface of the concrete covered with a damp-proofing material so as to prevent the damp rising and ultimately attacking the wood.

The wood fillets should be impregnated with tar, bitumastic or creosote under pressure before being fixed. It is advisable to have notches cut in the underside of the wood fillets at intervals along their length, as these will form air spaces to allow a free current of air to circulate under the floor boards, as in Fig. 66.

Several methods may be adopted to secure the battens to the concrete floor slab. They may be spiked to the concrete, but this arrangement destroys the continuity of the damp-proof layer. Special clips are obtainable which can be fixed before the concrete is set and before the damp-proof layer has been applied. When the whole of the floor surface has been covered with the damp-proofing material the wood battens are nailed or fastened to the floor clips. Dovetailed floor battens may be secured by being partially embedded in concrete, as shown in Fig. 67.

Timber Ground Floors on Sleeper Walls

Timber ground floors are usually situated from 18 in. to 30 in. above the concrete surface layer, and in such cases it is necessary to support the floor joists by means of piers or walls built up from the foundations or from the concrete surface layer. When the joists butt against a wall the

brickwork may be recessed for the wall plate, as in Fig. 45, or a timber bearer for the support of the joists may rest upon detached piers, as in Fig. 44. Alternatively, a sleeper wall may be built close to the inside face of the external wall and the timber plate bedded on the sleeper wall to carry the end of the joists.

The floor span can be reduced by building intermediate sleeper walls across the floor area, and this will economise in timber, as the span between the joists can be made to suit individual requirements and the dimension of the joist section reduced accordingly, as shown in Fig. 45. Care must be taken to ensure that damp is not allowed to rise through the brickwork of the sleeper wall or piers and thereby attack the timber beam. It is necessary, therefore, to incorporate a damp-proof course in the wall or pier unless the concrete surface layer has been covered with a damp-proofing layer.

Ventilation under the floor should be provided by building air bricks in the external brick wall below floor level. These air bricks may be of cast iron or terra-cotta, and they may vary in size according to requirements. Details of air bricks are given in Figs. 63 and 64.

Timber Upper Floors

Joists.—The support of joists at the wall end can be effected by corbelling out the brickwork in two or three courses until a total distance of 4½ in. is reached, as shown in Fig. 47.

A wall plate is then bedded on the top surface of the corbel course to form a bearing surface for the end of the joists. Alternatively, if the wall is of sufficient thickness it may be set back to provide a seating for the wall plate, as in Fig. 57, or the joist may be built into the wall. In the latter case it is preferable to allow the joists to rest on a metal plate.

Since it may not be possible to support the joists at any intermediate point in their span, they must

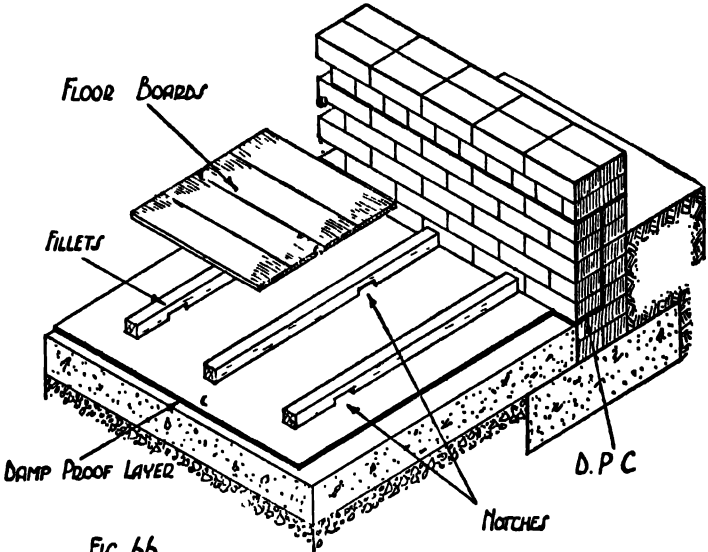


Fig. 66

Ground Floor Construction on Solid Floor

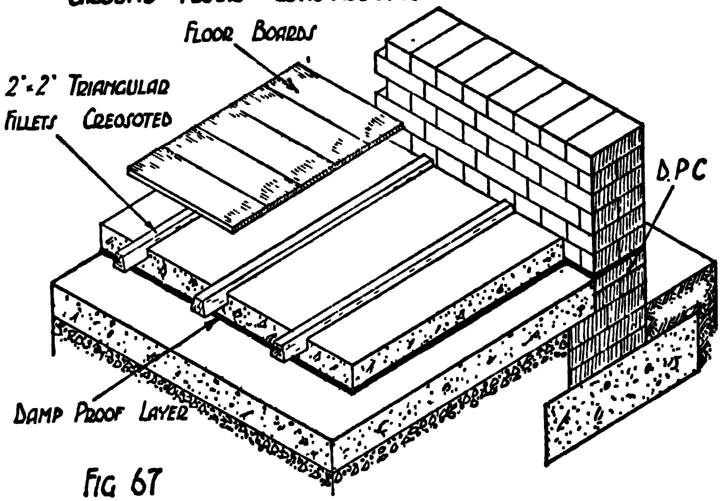


Fig 67

Ground Floor Construction on Solid Floor.

be sufficiently strong to carry the anticipated loads. A detail showing the construction of a timber upper floor partly supported on a partition wall is given in Fig. 46.

To determine the safe depth for joists, halve the span, measured in feet, call the result inches, and add 2 in. Joists should be spaced about 14 in. apart, centre to centre, and the span should not exceed 16 ft. in length.

When fireplace and other openings in floors have to be provided, the joists are trimmed or framed to suit the size of the opening required. The usual arrangement is to increase the thickness of the joist on each side of the opening. These joists are called trimming joists, and in order to obtain support for the intermediate joists, a trimmer joist is fixed across the space between the two trimming joists. The joint connection between the trimmer and trimming joist is usually obtained by forming a tusk tenon joint, details of which are given in Fig. 68. The intermediate joists are tenoned into and supported on the trimmer joist.

Strutting

In order to stiffen the floor joists and so prevent any tendency to side buckling, it is usually necessary to provide a system of strutting either across the centre of the floor span or at convenient intervals of approximately 5-ft. centres.

The most common method of strutting is the herring-bone type. Two struts are fixed diagonally between each pair of joists so that one end of each strut is at the top of the joist, while the other end is at the bottom of the opposite joist. The struts are placed in pairs, so that the direction is reversed. It is important that the struts are kept in the same parallel and straight line across the floor. A sketch of this type of strutting is given in Fig. 69.

Floor Boards

The most commonly used type of floor board is the

"*tongued and grooved.*" This is a board provided with a tongue on one edge and a corresponding groove on the other edge. See Fig. 70. When placed edge to edge and nailed, a good floor is provided. *Square-* or *butt*-jointed boarding may be used, but the disadvantage of this type is the possibility of the timbers warping and the joints

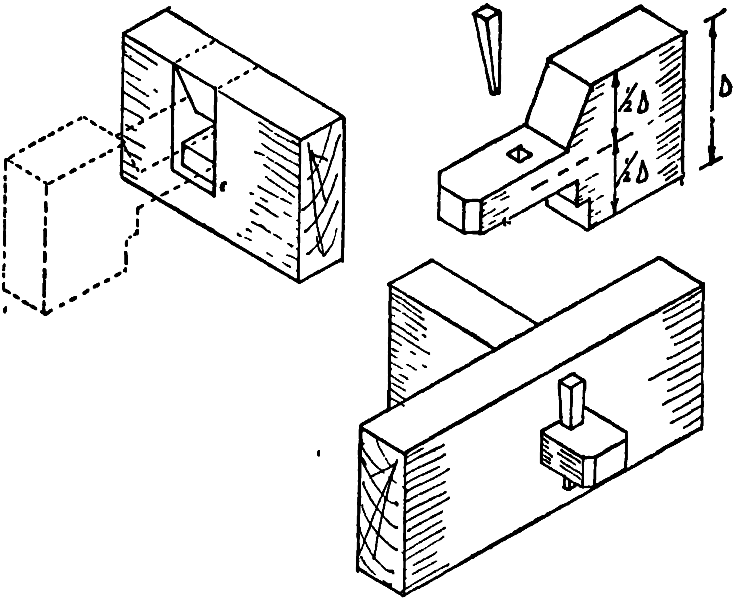


FIG. 68 TUSK TENON JOINT

lifting, also the occurrence of open spaces between the boards at a later date owing to the shrinkage of the boards. See Fig. 71.

Secret-nailed boarding is sometimes used, and this provides a good floor. The boards are rebated and splayed, as shown in Fig. 72, the nails being driven through the splayed portion to secure the boards to the joists.

Ploughed and *tongued boarding* has a groove on both

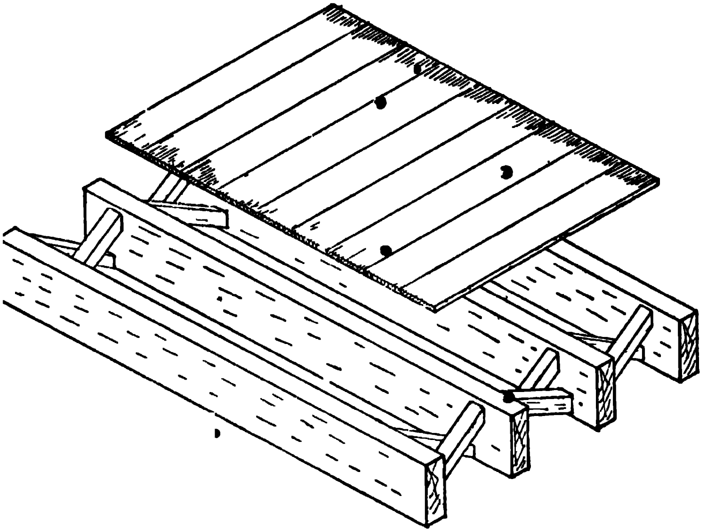


FIG 69 FLOOR STRUTTING

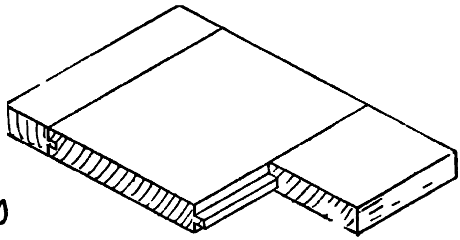


FIG 70

TONGUED & GROOVED FLOORING

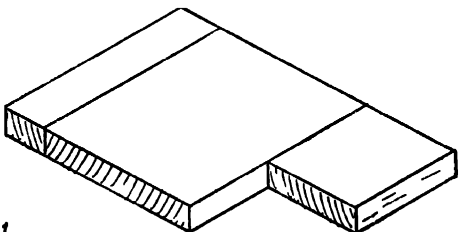


FIG. 71

SQUARE OR BUTT JOINTED FLOORING

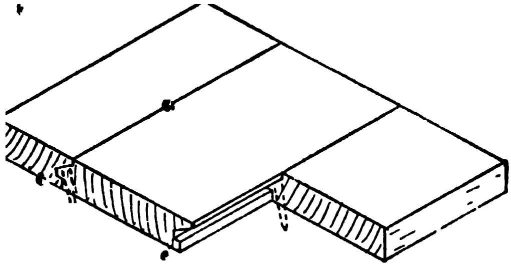


FIG. 72
SECRET NAILED FLOORING

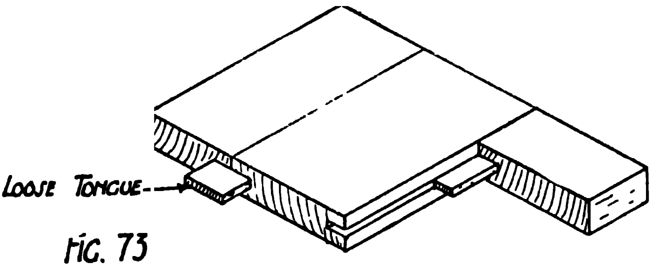


FIG. 73
PLOUGHED & TONGUED FLOORING

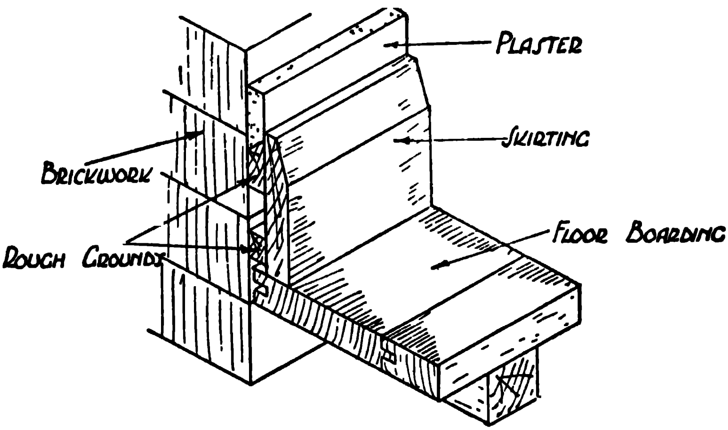


FIG. 74 FINISH OF FLOORING AT WALL

edges into which a hardwood or metal tongue is inserted, as shown in Fig. 73.

Before floor boards are nailed to the joists, a portion of the flooring is laid and cramped into position by means of floor cramps or timber wedges. This process of closing the boards ensures that they are fitting tightly together and thereby reducing the number and extent of open joints. A detail showing the usual type of finish for floor boarding at the junction of walls is given in Fig. 74.

CHAPTER VI

ROOF CONSTRUCTION

Pitched Roof

The terms applied to pitched roofs may be summarised as follows :—

Hip.—The projecting or external angle occasioned by the intersection of two pitched surfaces.

Valley.—The recessed or internal angle occasioned by the intersection of two pitched roof surfaces.

Eaves.—The finish at the lower portion or foot of a pitched roof. An eaves usually projects for some distance beyond the face of the supporting wall.

Ridge.—The apex of a pitched roof, or the intersection of the two roof surfaces at the top part of a pitched roof.

Verge.—The edges of the roof covering which overhangs the gable end.

Principal Rafters.—The raking members at the top portion of the roof truss framing, and upon which the purlins are supported.

Rafters.—The raking timbers which support the roof covering.

Hip Rafter.—The raking rafter at the external intersection of two pitched roof surfaces.

Jack Rafter.—The short rafters which are framed between the wall plate and the hip rafter.

Purlins.—The horizontal timbers which are introduced to give intermediate support to the rafters.

Tie Beam.—The horizontal member which ties in the feet of the principal rafters and forms the lower part of the truss framing.

Collar Tie Beam.—The horizontal member tying-in the rafters half-way up their length.

Ceiling Joists.—The timber framework upon which lath and plaster or other types of ceilings are fixed.

Wall Plates.—The continuous horizontal timbers bedded on walls to support the floor joists or the feet of roof rafters. Their function is to spread the imposed loads evenly over the length of the wall. Wall plates should not be butt-jointed, they should be connected by means of halved joints.

Sprocket Pieces.—The shaped pieces of timber fixed to the lower part of the rafters. They are used to ease the abruptness of the slope at the foot of a pitched roof and check the rapid flow of the rainwater when running down the roof surface, also to provide an extra tilt for the lower courses of tiles.

Tilting Fillet.—A triangular-shaped piece of wood which is used in roof construction to tilt the slates or tiles at the eaves.

Bearers.—Timbers placed at the underside of eaves and to which the soffit boarding is fixed.

Barge Board.—The boarding which is fixed at gable ends immediately under the slating or tiling and inclined to the same slope as the roof surfaces.

Soffit Board.—The boarding fixed to the bearers on the underside of the overhanging portion of an eaves. Its purpose is to seal the joints between the roof and the supporting wall.

Fascia Board.—The board which is fixed vertically at the extreme ends of the rafters at the eaves of a roof, and which forms a fixing for gutters.

Roof Boards.—The boarding fixed on the top surface of the rafters and upon which the slate or tile battens are fixed. Roof boarding prevents the infiltration of draughts and damp through the roof covering. The boards may be covered with roofing felt and then battened for the slates and tiles.

Battens.—The strips of wood which are fixed to the roof boarding or rafters, in correct positions, for the purpose of fixing slates or tiles.

Trimming.—Where chimney stacks, roof lights and

lantern lights occur, it is necessary to trim the roof rafters round the opening in a manner similar to that described for the trimming in timber floors.

Tusk Tenons.—The joint that is most commonly used for connecting the trimmer to the trimming joists.

A diagram plan showing the various members of a timber-pitched roof is given in Fig. 75A.

Types of Pitched Roofs

The type of roof which may be used is dependent upon the span of the roof. Trusses should be triangulated in form, that is, the component members should form triangles, upon which arrangement is the basis of all stable-framed structures. The normal distance apart at which roof trusses should be spaced is 10 ft., whilst the usual spacing for rafters is 12 in.

King-post Roof Trusses are suitable for spans from 20 ft. to 30 ft. The truss consists of two sloping members, which are called the principal rafters, and are intended to carry the intermediate purlins which in turn support the roof rafters, and are therefore in compression.

As the weight of the roofing is transferred to the wall at the feet of the truss, any tendency to spread is counteracted by the tie beam, which connects the feet of the principal rafters. This member is therefore subjected to tensional stresses.

To prevent the principal rafters "sagging" under the weight of the roof, struts are placed half-way down the rafters and framed into a vertical post called a King-post, which also acts as a central support for the tie beam.

In order that the King-post may fulfil this function it is framed into the principal rafter at the ridge and into the tie beam, the joint connection being strengthened by the addition of wrought-iron straps.

Timber King-post roof trusses are very seldom used in modern construction, their place having been taken by some form of steel roof truss.

Couple Roof.—Suitable for spans of about 12 ft. the roof framing consists of two sloping series of rafters meeting at the ridge and resting on wall plates which are bedded on the top surface of the walls. The feet of the rafte s are notch-jointed over the wall plate to prevent spread.

Close-couple Roof.—Suitable for spans of about 15 ft., the framing is similar in form to the couple roof, but a tie beam connects the feet of every third or fourth pair of rafters, thus producing greater strength and rigidity to the roof.

The lower end of the rafters should be notch-jointed over and nailed to the wall plate. See Fig. 76.

Collar Tie Roof.—Suitable for spans of about 18 ft., the framing is similar to the close-couple roof, but the tie beam is placed higher up the slope of the rafters in order to give greater head room in the compartment below. See Fig. 76.

Lean-to Roof.—Suitable for small spans up to 10 ft. As its name implies, it is a roof having a single pitch and which leans against a higher wall. It is mostly used as the roofing to sheds, porches, bay-windows, etc., and attached to the main structure. See Fig. 77.

The upper ends of the rafters should be supported on, and notch-jointed over, a wall plate, which is plugged to the main wall, the rafters being splay-cut against the face of the brickwork.

A brick corbel course may be built projecting from the brickwork face to carry the wall plate, as in Fig. 78, or the brickwork may be set back and the wall plate bedded on the wall.

The feet of the rafters are bird's-mouth jointed over a wall plate bedded on the wall; the lower end of the rafters may project beyond the face of the wall to form an eaves, as shown in Fig. 79.

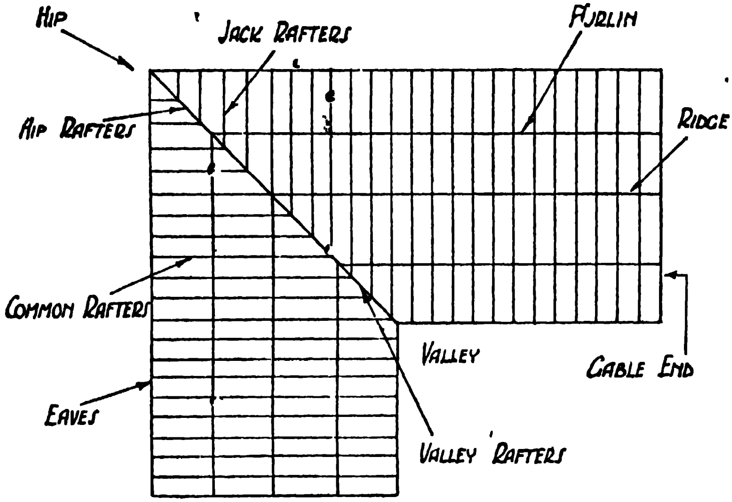


FIG. 75 SKETCH PLAN OF PITCHED ROOF

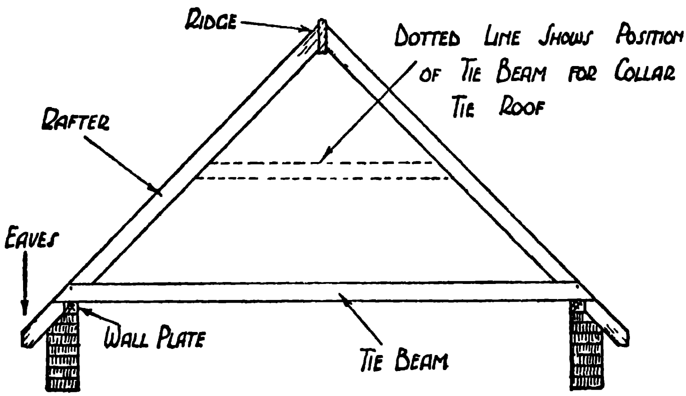


FIG 76 CLOSE COUPLE ROOF

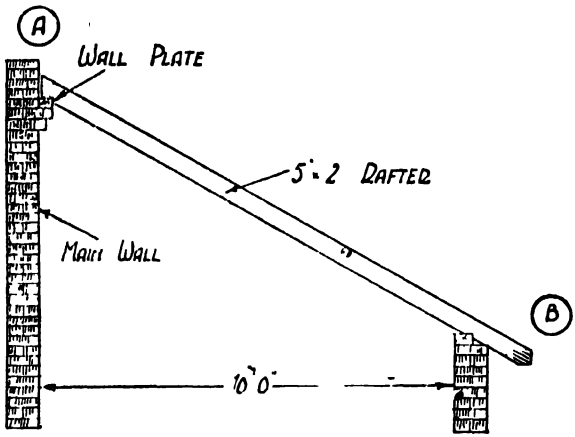


FIG. 77 LEAN-TO ROOF

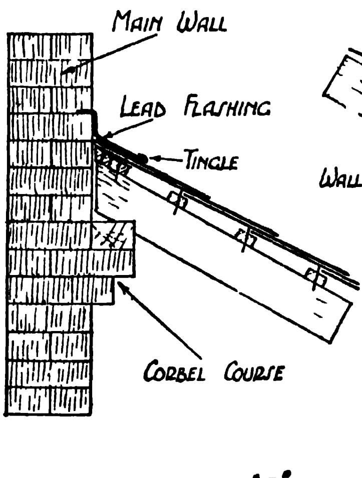


FIG 78 DETAIL AT "A"

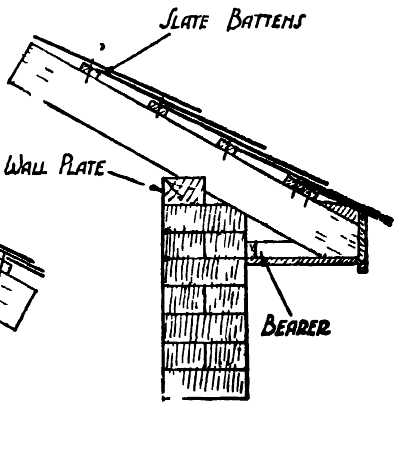


FIG 79 DETAIL AT "B"

Flat Roofs

Timber flat roofs are constructed in a similar manner to floors, except that they are laid to a fall, that is, the surface of a flat roof is not level but raised at one end in order that rainwater may run from the roof surface. In order to obtain the "fall," required, firring pieces are fixed on the top of the timber joists, as shown in Fig. 80.

Timber joists may be fixed on a wall plate bedded on the wall, or on a corbel course if desired.

The joists are usually spaced at 14-in. centres and these should be strutted along the centre of the span, but if the span is great the strutting should be placed at about 5-ft.

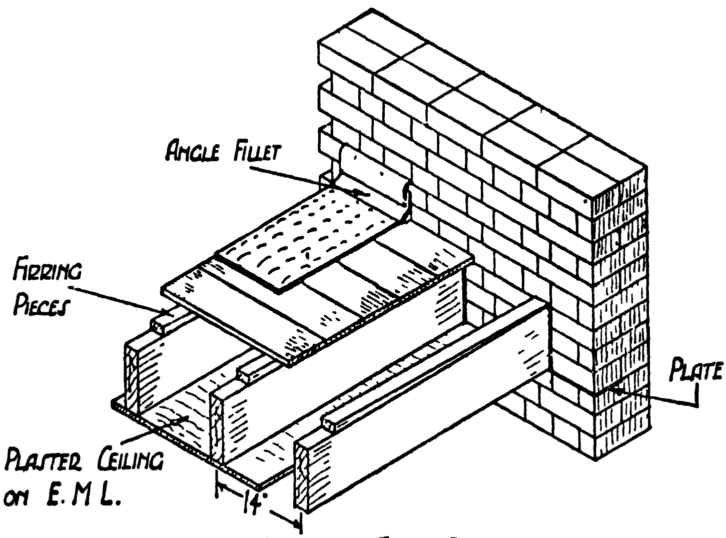


FIG. 80 TIMBER FLAT ROOF

centres. Herring-bone strutting is most commonly used as in the case of stiffening floor joists. There must be sufficient circulation of air around the roof timbers and, in order to provide for this, air bricks may be inserted in the wall at convenient positions. The fixing of cross-

firring pieces on the top edge of the roof members will assist in allowing the air to circulate around the members.

Gutters should be provided for the discharge of the rain-water, but when the roof is surrounded by a parapet wall, apertures may be formed in the wall at about roof level and the rainwater conveyed through the apertures and discharged into a rainwater or spout head, which is fixed to the external face of the wall and at the top of the rainwater pipes. The formation of a gutter behind a parapet wall is shown in Fig. 81.

Roof Covering

Lead.—Sheet lead will provide the best type of covering for flat roofs of small area. The lead should be laid on boarding which has been finished evenly on the top surface, or the boards may be covered with sheets of fibre board or roofing felt which should be laid butt-jointed.

To provide a watertight joint parallel to the " fall " and to allow the metal to expand and contract, the lead sheeting may be dressed over wood rolls or welt joints formed, but when a joint occurs at right angles to the fall, a drip is necessary. The size of the sheets of lead should not exceed 8 ft. × 3 ft. owing to the expansion and contraction which is likely to take place when the sheets are subjected to varying temperatures.

Wood rolls are pieces of timber about 2 in. × 2 in. in cross section and they are fixed on the roof surface after the roof has been boarded. The lead undercloak is dressed over the roll and fixed in position by close copper nailing.

The overcloak is then dressed over the roll in the opposite direction and the lead is terminated on the roof surface about 2 in. beyond the roll. See Fig. 82.

Welt Joints are formed by turning up the edge of one sheet of lead about 1 in., and also the adjoining sheet about 2 in., the latter edge being turned down over the

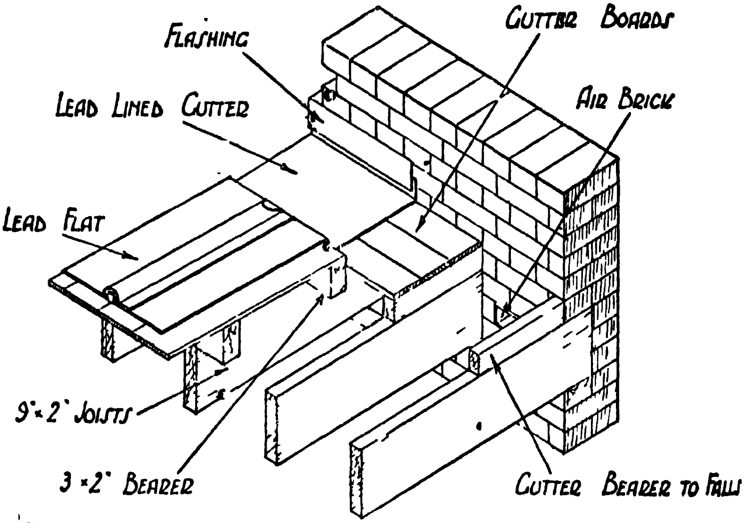


Fig 81 Lead Covering to Flat Roof

Fig 83 Lead Welt

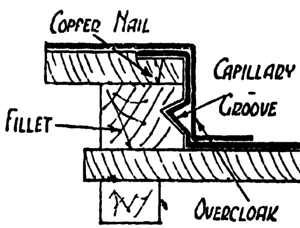


Fig 84 Lead Drip

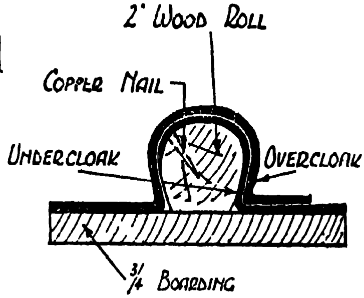


Fig 82 Lead Roll

first edge. The whole of the upstand is then bent down flat on the roof surface, as shown in detail in Fig. 83.

Drips are formed by stepping the roof surface to form a drop in the surface of about 2 in.

The lower sheet of lead is dressed up the face of the drip and to the contour of the capillary groove, then over the top edge of the boarding, which should be rebated to receive it. The edge of the lead sheet is close copper-nailed as a means of fixing.

The upper sheet is then dressed over the lower sheet and allowed to extend on the roof surface for approximately 2 in. beyond the face of the drip.

The capillary groove is provided in the wood fillet to prevent water creeping back between the two layers of sheet lead. See Fig. 84.

Lead flashing should be provided at the junction of walls and roof, the sheet lead roof covering being dressed against the vertical wall surface and also over an angle fillet situated at the angle formed by the wall and roof.

The flashing should extend over the top edge of the lead upstand and finish about 3 in. above the roof surface.

Felt.—A common form of roof covering, and one which is less expensive than lead, is formed with a bituminous felt. The felt may be laid in two layers on close boarding, but the boarding should be even surfaced and the felt of even thickness. The joints running in the direction of the fall should be welted as described for lead in order to ensure a watertight joint.

The rolls of felt are normally sufficiently long to obviate any cross joints, but if necessary a drip may be formed in a similar manner as described for sheet lead roof coverings.

Asphalte.—When applied on boarded roofs asphalte should be laid in two layers on roofing felt or cork fibre board, or other insulating material. Upstands in asphalte should be provided at junction with walls and the joint covered with flashing.

CHAPTER VII

INTERNAL FINISHINGS

Floor Coverings

Strip Floors.—The most common form of flooring in general use is strip flooring. This comprises narrow lengths of timber laid on the top edge of floor joists and nailed as previously described on page 80.

If the flooring is left without further covering it will need to be planed and sandpapered after laying.

Wood Blocks.—Where a polished hard-wearing timber floor is required, the use of wood blocks is the most suitable.

The blocks can be laid on concrete floors which have a screeded finish, but the concrete surface should be covered with bitumastic solution, or pitch and tar, before the blocks are laid. See Fig. 85.

Care must be taken that sufficient space is allowed between the edge of the wood block flooring and the surrounding walls so that any expansion of the blocks will not cause them to rise. Expansion space thus left should be covered by the skirting.

Tiles.—A hard-wearing floor surface, and one which is suitable for sculleries, bathrooms, etc., is obtained by forming the floor surface with tiles. See Fig. 86. The most common type of tile used for flooring is the quarry tile, which is 6 in. × 6 in. in size, but other types of tile may be used according to requirements and taste. Tiles when used as a floor covering are bedded in Portland cement on a cement mortar screed.

Jointless Flooring.—A flooring composed of a cement screed containing an aggregate of marble or granite chippings and known as Terrazzo makes an effective flooring surface when laid on concrete, but in order to prevent surface cracks appearing it is advisable to divide the floor area into small units.

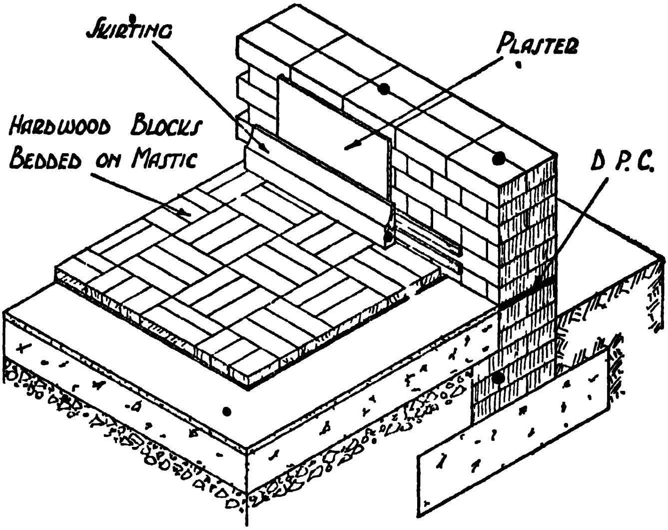


FIG 85 FLOORING - WOOD BLOCK

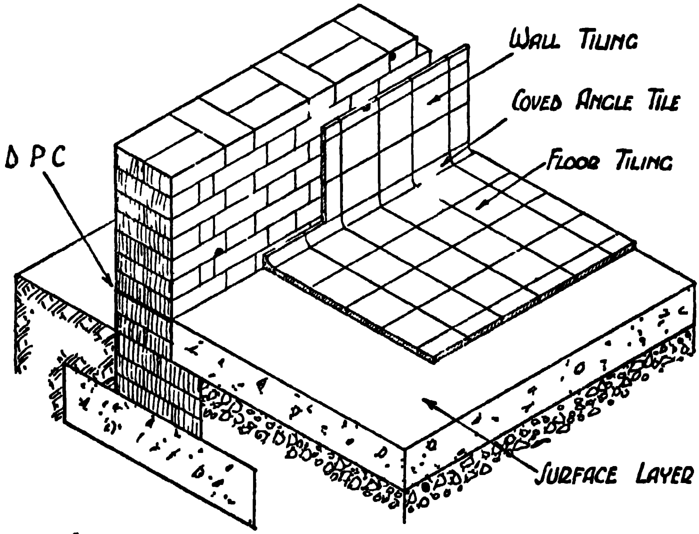


FIG 86 FLOORING - QUARRY TILE

A mixture of calcined magnesite, with an aggregate of sawdust, wood flour, or powdered asbestos gauged with a solution of magnesium chloride, also makes an excellent jointless flooring material. The floor surface is formed in a similar manner to a cement screeded floor.

Concrete.—A concrete floor may be screed-finished, but this type of finish will not produce a hard-wearing surface. If a hard-wearing floor is required, granolithic paving may be used, or a small proportion of carborundum may be added and mixed with the cement.

Linoleum may be laid on wood flooring or it may be laid on a concrete floor slab, but when linoleum is laid on concrete it should be kept in position by means of a rubber adhesive solution.

Rubber Tiles.—Rubber may be laid on a level cement screed and secured to the floor by a rubber adhesive. It is better laid in the form of tiles.

Skirtings are the horizontal members placed at the junction between the walls and floors, and the function of a skirting is to cover the joint between the wall and floor finishings.

Skirtings should be of simple section and about 6 in. high, the material and detail used being in accordance with the floor finishings.

Deal and hardwood skirtings should be fixed to the wall on deal grounds. These grounds are fixed before the plastering has commenced, so that they act as a screed and also as a key for the plaster work. The top grounds are splayed along their upper edge for this purpose. Vertical or soldier grounds may be fixed in lieu of horizontal grounds.

When horizontal grounds are used, the space between the grounds and the floor is usually filled in with plaster, and this process is called rough rendering. A detail showing the fixings for a skirting is given in Fig. 74.

To ensure that no space is caused between the floor and the skirting due to shrinkage the skirting may have a

tongue formed along its bottom edge and this is housed in a corresponding groove formed in the floor boarding.

Alternatively, a small bead may be planted on to the floor to cover the angle between the floor and the skirting.

Should linoleum be used as the floor covering, this small bead may cover the edge of the linoleum and keep it in position.

Tiled floors may have a special tile-coved skirting which should be bedded in cement.

Doors

The construction and type of door used are governed by its position in the building.

Frame.—The timbers which follow round the door opening and which carry the door are called the frame.

The usual size of the members comprising the frame is 4 in. × 2 in. or 4 in. × 3 in., and the members are usually rebated to receive the door. Sometimes, in cheap types of work, a stop is planted on the frame in lieu of the rebate. Where the doorway is an external one, the brickwork jambs at the sides of the opening may be recessed so that when the door frame is fitted in the rebate the wind and the rain are prevented from passing to the interior of the opening. If the jamb is not recessed, the frame will fit against the face of the jamb, in which case the joint between the jamb and the frame can be covered with a screwed bead.

Linings.—Instead of returning the plaster-work or other wall finishings around the door jamb, a wood lining is often used to form the jamb. Linings will vary in width according to the thickness of the wall, and will consist of a deal or hardwood frame 1½ in. thick and probably the full width of the door jamb, rebated to receive the door and screwed on 2 in. × 1 in. grounds which are plugged to the walls, as shown in Fig. 87.

When a rebated door frame is fixed to receive the door, the linings may be housed into the frame in lieu of continuing straight through. This construction would apply

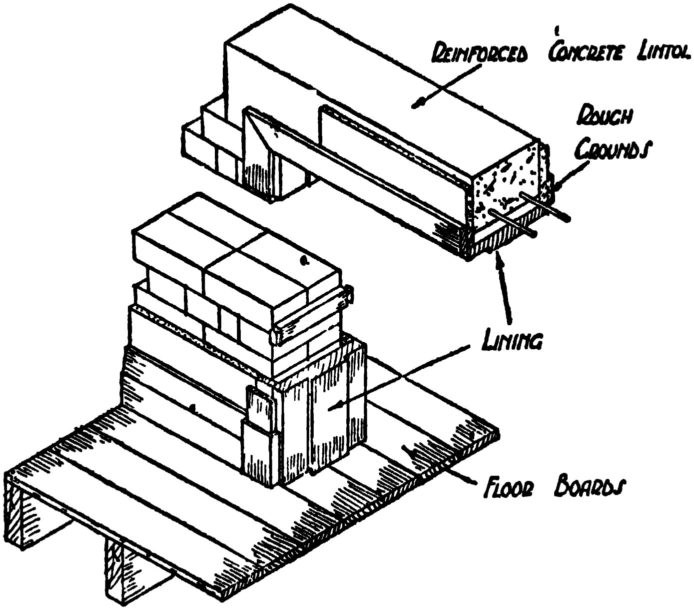


FIG. 87 LININGS TO DOOR OPENING

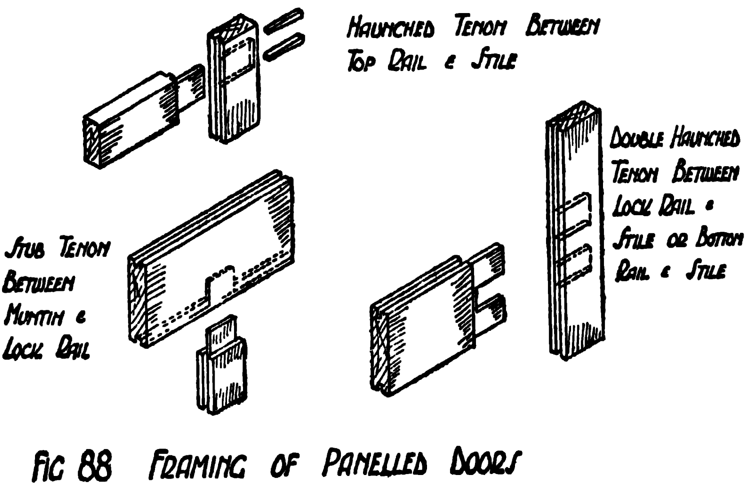


FIG 88 FRAMING OF PANELLED DOORS

chiefly to external doors. Linings should continue round the jambs and head of door and window openings.

Grounds.—Finished joinery should not be fixed until the plaster has dried out. As in the case of skirtings, rough or wrought grounds are plugged to the brickwork around the door opening, and these will act as a screed for the plaster-work and also as a fixing for the architrave or other joinery.

Architraves.—In order to cover the joint between the plaster and the grounds, an architrave member may be fixed to grounds and made continuous along the jambs and head, as shown in Fig. 87.

A built-up architrave may be constructed if desired.

Ledged Doors consist of vertical boards, either tongued and grooved or butt-jointed and screwed to horizontal ledges which are placed at the top, middle and bottom of the door.

Diagonal braces may be fixed if desired, making what is known as a "ledged and braced door," the lower end of the braces being on the hinged side of the door.

Framed Ledged and Braced Doors consist of two stiles and top rail the full thickness of the door, while the middle or lock rail, the bottom rail and the braces are made less than the full thickness of the stiles by the thickness of the boards. See Figs. 122 & 123.

Panelled Doors.—There are many types of doors which come under this heading, but they are governed by the same construction. A frame is constructed consisting of stiles, top, bottom and middle rail, and, if desired, an intermediate vertical rail termed a muntin may be included. The framing connections between the top rail and the stiles are made with haunched tenon joints, while the joints between middle or lock rail and stiles, and also bottom rail and stiles, are formed with double-haunched tenons. Stub-tenoned joints should be formed between the muntin and each rail. The rails, muntin and stiles are grooved to receive the deal or hardwood panels, and these are

inserted before the door is fully framed up. When this is done, there should be a space existing between the framing members and the edges of the panel boarding to allow free movement of the panels so that they can expand and contract at will. Beads and mouldings may be planted, if desired, to act as a means for covering the joint between the panel and the rail, etc. With this construction, should any shrinkage of the panel take place, it will not be apparent. Details of the joints for framing a panelled door are given in Fig. 88.

Flush Doors.—There are several forms of construction for flush doors, the method adopted being suitable for the purpose for which they are required. The general form of construction makes it adaptable for resistance to sound and temperature changes, and consists of a frame, similar to that of a panelled door, and a veneer fixed right over the frame on both sides of the door. As a backing to the veneer, plywood may be fixed to the frame and the veneer fastened or glued on to the plywood. Other forms of construction for the skeleton frame may be used and many patent types of construction are on the market.

Double Doors.—When openings are too wide for a single door, two leaves may be used. The construction is similar to that of single-type doors with the exception of the meeting stiles which are rebated, unless the doors are intended to swing past one another.

Metal Doors.—These may be solid metal doors, consisting of a steel framework and sheet panelling, or if they are of the flush-door type, they may have a timber skeleton framework with metal veneer sheeting fixed to and covering the whole of the skeleton framework.

External and Internal Doors.—The types of doors already mentioned may be fitted both in external or internal doorway openings, but a slight modification may be necessary in the case of an external door in order to keep the weather from penetrating the door opening. To prevent the penetration of the rain under the door, a

weather fillet in the form of a drip may be fixed on the bottom rail.

Door Hanging

The most common method of hanging doors is by means of butts or hinges. The number to be used for each door depends upon the size and weight of the door.

Ledged and braced doors are usually hung on cross-garnet hinges.

For swing or folding doors special types of floor spring are used.

Windows

Wood Sashes.—The two main types of sashes are double-hung and casement sashes, but other types are also used, such as sliding and pivoted sashes.

Double-hung Sashes consist of a cased or boxed frame, which is usually fixed in a recess formed in the jamb of the brickwork at the sides of the opening, as shown in Fig. 89.

The boxing is built up to receive the metal weights which are intended to balance the weight of the sash and thereby assist in the raising and lowering of the window.

The sashes run in grooves formed by the projection of the casing and a parting bead The casing returns across the head of the window.

The horizontal meeting rails between the sashes are made wider than the sash, and the joint surfaces between the rails splayed and rebated to close the joint.

Casement Sashes.—This type of window comprises a solid frame which is plugged to or built into the brickwork surrounding the opening, the brick jambs being recessed or straight through as desired. The frame consists of two stiles or posts, head and sill. See Fig 90.

Mullions and transoms may be incorporated if desired. The sashes are made to open outwards or inwards according to requirements.

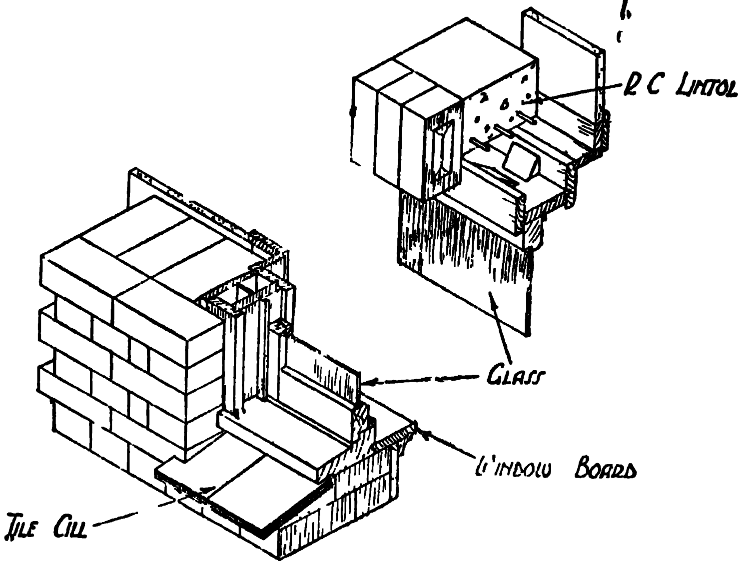


Fig 89 Double Hung Sash

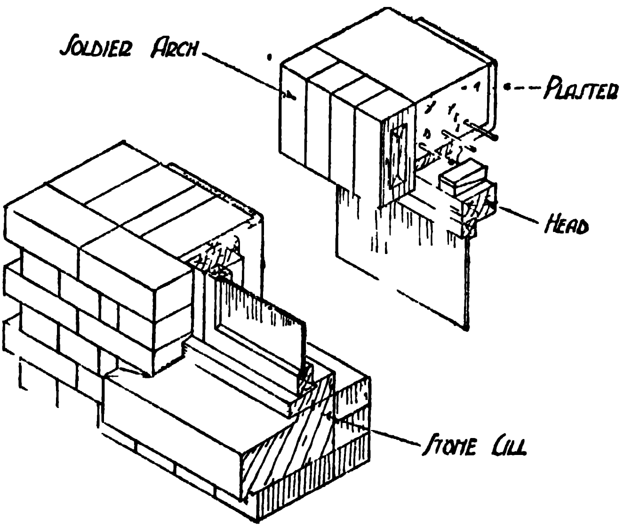


Fig 90 Casement Sash

The transom divides the window horizontally, thus forming top lights and at the same time acts as the head to the lower light casement, and the sill to the fanlight. Mullions divide the window vertically into a number of lights. A casement frame is referred to according to the number of lights into which it is divided, such as two-light or three-light.

Sills are similar in form for both types of window and should be sunk, weathered and throated. If the casement is to be bedded on a stone sill the wood sill should be grooved and a corresponding groove made in the stone sill. A galvanised-iron or other non-corrosive metal bar is placed to fit into the two grooves which are filled in with red lead. This arrangement will provide a watertight joint between the wood and stone sill.

Metal Sashes.—It is more usual to fix metal sashes direct against the brick or stone jambs, but should it be so desired, the sashes may have a wood frame surround.

The metal frame is secured by means of lugs which have been built into the brickwork, or the whole frame may be let into a small recess and bedded in putty and wedged.

Sashes may be hung side-hinged or top-hinged and made to open according to requirements.

The frame consists of a series of light channels or similar sections manufactured out of steel or bronze.

The sill upon which the lower portion of the metal frame rests should be rebated to receive the metal frame in such a manner that rainwater will be excluded and discharged clear of the wall surface.

The base of the window opening on the inside may be provided with a wood window board similar to the base finish to a wood window frame.

Ironmongery, Internal Fittings and Furniture

Crossgarnet Hinges consist of an arm about 12 in. to 20 in. long, tapered and fixed to the door by screws. The

other arm is about $1\frac{1}{2}$ in. long by 5 in. broad and fixed to the frame.

Strap Hinge consists of a long arm and plate. The arm is screwed to the door and the plate to the frame. A cylindrical eye is formed on the end of the arm to receive a pin which is welded or riveted to the plate. When the hinge is to be fastened to brickwork, a lug with a pin welded on to it is formed and inserted in the joints of the brickwork. The eye of the long arm is clipped over the pin to act as a pivot upon which the hinge will move. See Fig. 130.

Butts are the most usual type of hinge for hanging doors and sashes. They are made in various metals, such as wrought iron, steel, brass, bronze, bronze-metal antique, etc. They consist of two flanges which are held together by a pin, but if it is desired the butts may be obtained with removable pins, thus allowing for the easy removal of doors. See Fig. 128.

Rising Butts are used where it is required to raise a door when it opens so that it may clear a carpet, etc., and to make the door self-closing.

For ordinary doors a pair of 4-in. butts will be sufficient to carry the weight, but for larger doors it may be necessary to have one and a half pairs fitted.

When butts are fitted, the wings of the hinge are recessed almost flush with the edge of the frame and the edge of the door stile, thus permitting the door or window sash to close tightly without springing the hinge.

Locks may be divided into two classes: (1) those attached to the face of the door, and (2) those mortised into the stile.

Rim Lock is a lock that is attached to the face of the door by means of screws, the door is perforated for the insertion of the key and spindle, the latter being operated by the knob. The type of key used has a long shaft which operates a " dead " bolt. The term " dead " means that the lock is not self-locking, as the bolt has to be deliberately thrown by turning the key. See Fig. 91.

Mortise Lock is a lock that is fixed into a mortise cut into the stile of the door at the height of the middle or lock rail. The whole lock is inserted in the mortise, the plate being recessed flush with the edge of the door.

Perforations through the door are made for the spindle and key, but only a small-shafted key is necessary with this type of lock. See Fig. 92.

Yale Lock is a patent type of lock and is attached to the face of the door in the same manner as a rim lock. The cylindrical portion of the lock is inserted in a perforation made through the door, and the lock is self-locking. It may be operated by a knob on the internal face and a short-shafted key is required for the purpose of operating the lock from the outside.

Latches.—Whereas a lock secures a door against entry unless a key is applied, a latch is operated on both sides of the door. To secure a door provided with a latch, a dead bolt is usually fitted either as part of the latch or as a separate fitting.

Norfolk Latches consist of a plate which is screwed to the face of the door, a handle for opening the door, and a lift bar for raising the latch bar. The door is perforated to receive the lift bar. See Fig. 93.

Ashpit Latch.—A keeper is fixed on the door which supports the bar. The bar is pivoted and raised by means of a knob attached to it. A lift bar operates it from the other side of the door.

Rim Latch is a spring-locking latch similar to the rim lock, but with this exception, it has no key-locking device. The door knob operates the latch, but a locking slide and small bolt may be incorporated in the fitting. See Fig. 94.

Night Latch is similar to a rim latch, but is not operated by a handle. Instead, a small knob which will slide draws the bolt back in order to free the door.

Furniture

Striking Plate.—Plates which are fitted to the door frame

to take the wear of the mortise lock opening and closing. The plate fits around the sinking made in the frame for the latch and bolt when thrown.

Box Staple.—A small box screwed to the frame to receive the bolt of a rim latch or lock.

Key Plate or Escutcheon.—A small metal plate which is screwed over the keyhole to prevent the wearing away of the wood by constant insertion of the key.

Finger Plates.—Plates screwed to the stile of the door just above and below the lock in order to prevent the wearing of the paintwork through handling. See Fig. 95.

Kicking Plates.—Plates which are screwed to the bottom rail of the door where there is a liability of the bottom of the door being damaged by kicking. See Fig. 96.

The knob and finger plates may be obtained in various materials according to individual requirements, but brass, bronze, bronze-metal antique, bakelite and chromium are the most commonly used.

Stairs—Terms

Staircase.—The area allotted to accommodate the stairs or the compartment which contains the stairs.

Flight.—The series of steps connecting one landing or floor with the next and forming the means of ascending or descending from one floor to another.

Landing.—The horizontal platform situated between floor levels and incorporated when the stairs change direction.

Tread.—The horizontal top portion of a step.

Riser.—The vertical front portion of a step.

Going.—The width of the tread from one riser to the face of the riser immediately above or below it.

Rise.—The height from the top of one tread to the top of the tread immediately above or below it.

Pitch.—The angle made with the horizontal plane by joining the nosing of each step in a flight.

Step.—The combination of a tread and a riser.

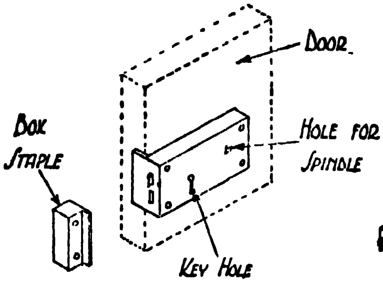


FIG. 91 RIM LOCK

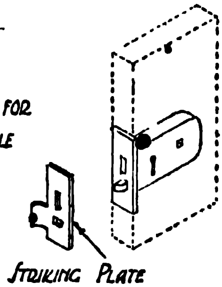


FIG. 92 MORTISE LOCK

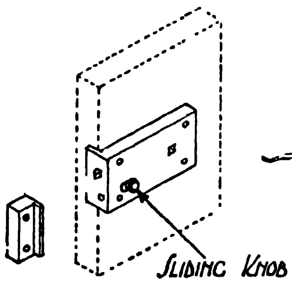


FIG. 94 RIM LATCH

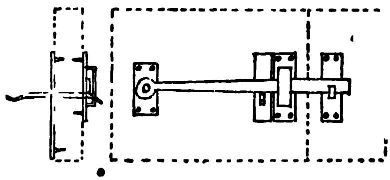


FIG. 93 NORFOLK LATCH

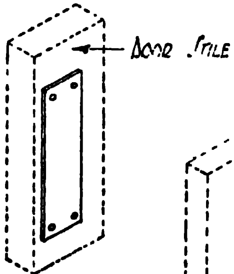


FIG: 95 FINGER PLATES

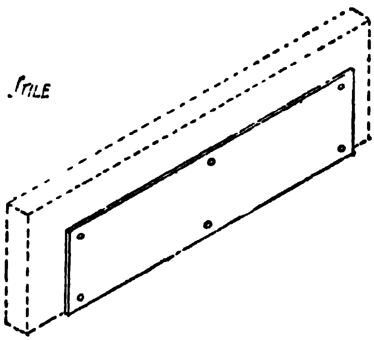


FIG. 96 KICKING PLATES

Nosing.—The front portion of a tread often projecting in front of the riser to give greater width to the tread.

String.—The diagonal or running members situated at the ends of the stairs and which support same. They may be "closed" or "housed."

Cut String.—The upper edge notched to support the steps.

Wall Strings.—The strings next to a wall which support the wall end of steps.

Outer Strings.—The strings supporting the steps farthest away from the wall.

Carriage.—The intermediate support to wide stairs. The carriage may be notched to receive the stairs.

Trenching and Housing.—The shaped recesses formed in the strings to take the steps.

Winder.—The triangular-shaped stairs placed at the turn in a flight and introduced when the staircase is limited in size.

Newel.—The vertical post into which the strings and handrails are framed at points in the change of direction of the stairs.

Balusters.—The small individual section posts which form units in the balustrading.

Handrail.—The horizontal or inclined hand support at the side of a stair and situated at a convenient height above the treads.

Types

Stairs may be built in wood, stone, concrete, marble, etc., according to individual requirements.

Wood Stairs consist of a framed casing which is tongued and grooved, joint-glued and blocked. The tread, which is usually of thicker timber than the riser, may be tongued and grooved or butt-jointed to the riser, the joint being covered by a small bead.

Stability will be given by gluing triangular blocks on the back surfaces of the treads and risers and by inserting wedges in the housing formed in the strings.

Solid Stairs built of stone, concrete or any similar material are usually built as solid units, the ends of the steps being built into the wall.

Spandrel steps are those which have had their under-surface splayed to the same angle as the pitch of the stairs.

CHAPTER VIII

SLATING AND TILING

Terms

Gauge.—The distance apart of the battens, centre to centre.

Margin.—The length of the surface of the slate or tile exposed to view.

Lap.—The distance that one slate or tile overlaps the next but one below it. The pitch of the roof determines the amount of lap.

Bed.—The underside of a tile, being normally concave for plain tiles.

Head.—The top edge of the slate or tile as laid on the roof.

Tail.—The lower edge of the slate or tile as laid on the roof.

Torching.—The process of filling up the back or underside of the slating or tiling with mortar in order to prevent wind and rain entering the roof space.

Slating

Types and Sizes.—Slates are made in many varying sizes according to the part of the country in which they originate. They can be as small as 12 in. × 8 in. or as large as 24 in. × 14 in., but the most common sizes in use are:—

Duchess	..	24 in. long ×	12 in. wide.
Countess	..	20 in. „	10 in. „
Ladies..	..	16 in. „	8 in. „

The choice of a slate will depend upon its colour, texture and weight, combined with pitch of the roof to be covered. The least pitch for a slated roof is approximately 30 degrees.

Fixing.—Slates may be centre or head nailed. The advantage of centre nailing is that slates may be easily

replaced if broken, and also the leverage caused by the wind is less than when a head-nailed slate is used.

The advantage of head-nailed slates is that the nail holes are well protected should the margin of the slates in the course above be broken.

To obtain the gauge for centre-nailed slating, take the length of the slate, deduct the lap (which is normally taken as 3 in.) and divide the remainder by two, thus: $\frac{\text{length} - \text{lap.}}{2}$

For head-nailed slates the gauge is obtained by taking the length of the slate and deducting the lap, to which has been added 1 in., and dividing by 2, thus: $\frac{\text{length} - (\text{lap} + 1 \text{ in.})}{2}$.

The battens having been nailed in position, the slates are nailed to them, commencing at the eaves and working each successive course up the slope of the roof. See Fig. 97.

Preparation for Slating.—Before slating can be commenced, the roof has to be prepared to receive the slates. This may be done by covering the roof rafters with close-boarding, the edges of the boards being either square or tongued and grooved, and the slates nailed direct to the board. This method will make possible the use of slates of varying sizes in certain courses.

The best method is to fix battens on to the boarding to receive the slates. The battens will be spaced according to the length of the gauge and measured from centre to centre and nailed to the boarding. See Fig. 98. If desired, roofing felt may be laid on the boarding before the battens are nailed. The boarding and battens are laid horizontally on the roof surface. The sizes of slate battens are usually 2 in. × $\frac{3}{4}$ in.

Nails.—Each slate should be nailed to the batten with two copper or composition metal nails. Iron nails should not be used owing to their liability to rust and break. Composition nails are made from zinc and copper.

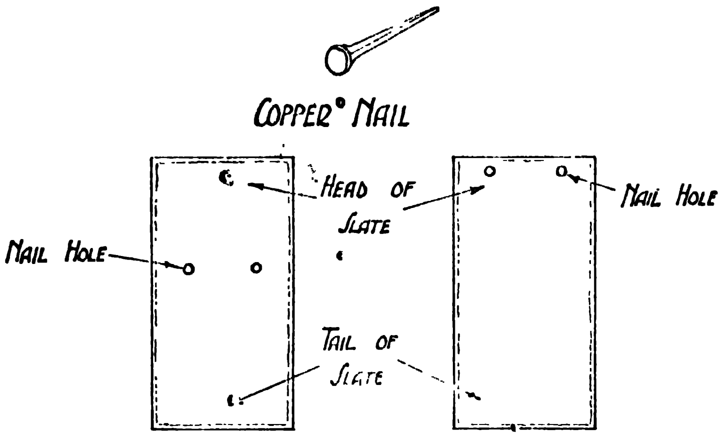


FIG. 97 SLATES
CENTRE NAILED HEAD NAILED

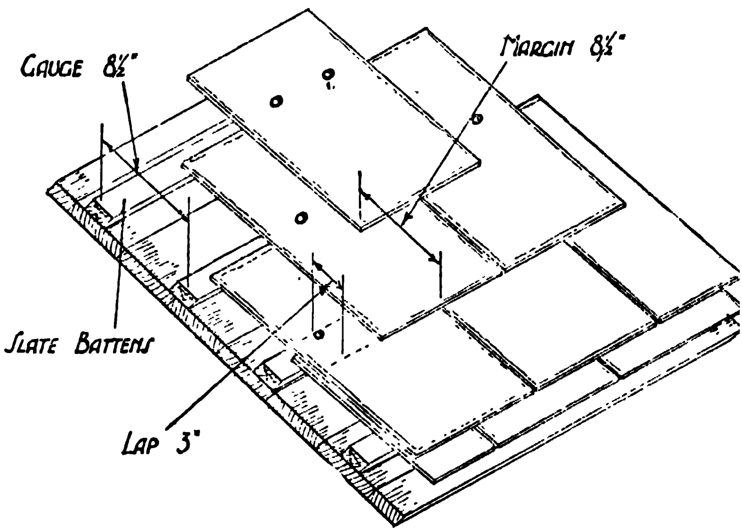


FIG. 98 SLATING TO BOARDED ROOF

Slating at Eaves.—A double course of slates is provided at the eaves of a roof in order to form the appropriate lap and, incidentally, to strengthen the bottom course of slates. The length of the under slates at an eaves should be equal to the margin plus the lap for centre-nailed slates, while an extra inch should be added for head-nailed slates. See Fig. 79. These slates comprise the first course to be fixed on a roof when slating.

The first few courses of slates should be tilted by the incorporation of a tilting fillet, as this will ensure that the slates will rest on their tails and become close-jointed along their bottom edge. The eaves slates should overhang to the centre of the gutter so that the water is thrown into it.

Slating at Valleys.—In order to secure a watertight joint at the valleys, sheet lead may be placed over the angle of intersection of the roof surfaces, an angle fillet being fixed at the junction of the roof boarding to ease the angle formed by the intersection of the two roof surfaces.

A tilting fillet should be placed on either side of the valley and against the edge of the valley boards so as to form a gutter and to slightly tilt the edge of the slates adjoining the valley.

The lead covering should be dressed over the angle fillets and the tilting fillets, and the slates cut obliquely and stopped short just beyond the tilting fillet. By these means the water will run down the valley gutter to the eaves gutter and be prevented from soaking under the slates by the interruption of the tilting fillets.

Another method of forming a watertight valley is to mitre the slates adjoining the valley and lay them on lead soakers.

Slating at Hips.—When the slating meets at a hip the slates may be cut to the angle of the hip and close-mitred and laid on lead soakers.

Another method for making a watertight joint along the hip is to fix a wood roll over the angle and then cover it with sheet lead.

Slating at Verges.—A verge is formed by continuing the slating over and beyond the face of a wall. It is necessary in such cases to provide for an extra course of slates to be placed under the battens and bedded on the wall. The ends of the battens are usually raised so as to rest on the lower course of slates, the roofing slates being laid in the normal manner, the space between the under slates and the roofing slates being filled in with cement mortar to form a weathertight joint.

Intersection with Chimney Stack.—When a chimney stack is encountered or passes through a slated roof, it is necessary to finish the slating close to the sides of the stack, the slates being cut where necessary. Lead soakers are placed on the top of each slate and turned up the face of the stack. The length of the soakers should be equal to the gauge plus the lap plus 1 in., the extra inch being allowed for turning the soaker over the top of the slate as a means of fixing. The width of the soaker should be about 7½ in., thus allowing for a 3½-in. upstand and 4 in. on the roof surface. The slate above the soaker should cover the soaker fixed to the head of the slate underneath.

After the slating has been completed, a stepped cover flashing is fixed in the bed joints of the brickwork of the chimney stack and allowed to cover the joint between the slating and the wall face. The cover flashing, which consists of a shaped piece of sheet lead cut in the form of steps, is placed over the upstand of the soaker against the wall, the top of the stepped portion being tucked into the horizontal joints of the brickwork and made secure with lead wedges and then pointed with cement mortar.

The slating at the back of a chimney stack is usually finished so that the rainwater is discharged into a gutter which should be boarded and provided with a tilting fillet.

The gutter boarding and tilting fillet should be covered with sheet lead and the joint against the brickwork of the chimney stack flashed as before described.

The slating at the front of the stack should finish against

the brickwork of the stack and the joint covered with a piece of sheet lead termed an apron.

A portion of the apron should rest upon the top surface of the slates and the ends of the apron covered with the lower portion of the lead soakers at the sides of the stack.

Slating at the Ridge.—In order to nail the top course of slates tight against the ridge it will be necessary to provide an extra batten at the ridge, the under slate being kept back about 2 in. in order to allow for this. There are several methods of providing a watertight joint at the ridge, but the following may be taken as usual practice:—

A wood ridge roll is fixed to the top edge of the ridge board, the slating brought up to it, and the sheet lead is dressed over the slates and the roll, the lead being kept in position by means of copper tingles placed at intervals along the ridge.

Another method is to fix a ridge slate over the intersection of the roof surfaces. The ridge slate consists of a solid piece of slate with a movable slate wing attached. This wing enables the ridge slate to accommodate itself to the pitch of the roof.

Tiling

Types and Sizes.—Tiles are made about $10\frac{1}{2}$ in. long $\times$ $6\frac{1}{2}$ in. wide $\times$ $\frac{1}{2}$ in. thick. They are usually concave on the bed, which causes the tail of the tile to fit closely against the tile underneath. See Fig. 99. The type of tile to be used will depend upon colour, texture and architectural requirements. Tiled roofs should have a pitch of not less than 45 degrees.

Fixing.—The fixing of tiles is different from that outlined for slates. The two projecting lugs at the head of each tile are intended to clip over the battens and so secure the tile.

Each tile has two nail holes at the head, but it is only necessary to nail the tiles at every third or fourth course.

The tiles are laid, as in the case of slates, commencing at the eaves, the amount of lap required will determine the gauge. A 3½-in. lap will allow a 3½-in. gauge, while a 2½-in. lap will allow a 4-in. gauge. See Fig. 100.

Preparation for Tiling.—Tiling may be fixed on to wood battens, which may be fixed direct on to the top edge of the roof rafters, but in such cases it will be necessary to "torch" the joints on the underside of the tiles so as to prevent the entry of rain and wind into the roof space. It is better, however to board the roof with square-edged, or tongued and grooved boarding, and then nail the battens to the boarding. This procedure will make the "torching" of the underside unnecessary.

Roofing felt may be laid on the boarding and under the battens, as in the case of slating, if desired.

Battens will not be necessary if feather-edged boarding is used.

The size of tile battens is usually 1 in. × ¾ in. or 1½ in. × 1 in.

Nails may be made of zinc or a composition metal and, as in the case of slating, iron nails should not be used.

Tiling at Eaves.—A double course of tiles is provided at the eaves in the same manner as for slating; the first course of tiles being bedded on a tilting fillet.

Tiling at Hips.—There are various types of hip tiles that may be used to cover the mitred angle made by the tiles at the hip of a roof. A common form of finish is obtained by using half-round ridge tiles, or specially formed tiles with lapped joints. These are bedded in cement mortar, while a galvanised-iron hip hook is screwed to the hip rafter at the foot to hold the bottom hip tile in position and thereby prevent the tiles slipping. The joints between the tiles should be filled with mortar and pointed with cement and sand.

Tiling at Verges.—The verges may be constructed in the same manner as for slating. "Tile and a half" tiles may be used on the under course.

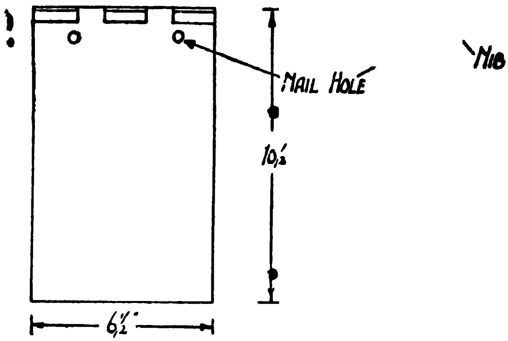


FIG 99 ROOF'NG TILE

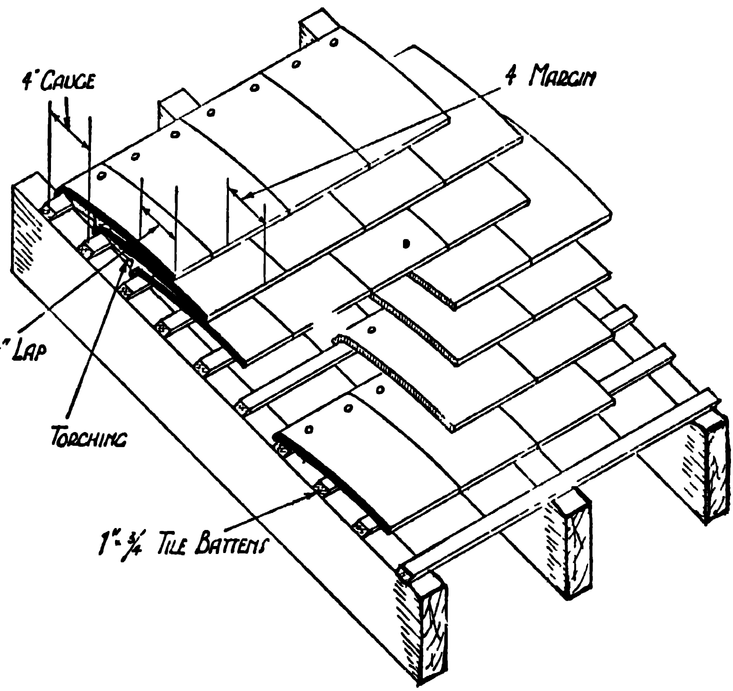


FIG 100 TILING TO BATTENS

Tiling at Stack.—The construction may be taken the same as for slating.

Tiling at Ridge.—As in the case of the hips, special tiles are manufactured to cover the ridge.

There are many forms of tile used for this purpose, the most common being the half-round ridge tile. The tiling is finished at the ridge in the same manner as described for slating, the ridge tile or capping being bedded in mortar directly on to the top course of tiles and the joints between the tiles filled with mortar and pointed with cement and sand.

CHAPTER IX

PLUMBING

Internal Services

When water is " laid on " in a building the pipes which carry the water into the building and distribute it throughout the building are called the service pipes.

The pipe enters the building at a convenient place and is taken directly up to the roof and connected to the water cistern. This pipe is known as the rising main.

The provision of a cistern in the roof space, which supplies the water to the water waste preventers, is compulsory under many local building by-laws. This storage cistern will also feed the various fittings, such as lavatory basins and boilers for the hot-water system. Drinking-water taps should be connected direct to the rising main and not to pipes which are fed from the storage cistern, which may be contaminated.

The sizes of pipes will depend on the demands to be made on the water system, but for an ordinary house a ¾-in. diameter pipe from the connection with the water company's main, up to the cistern, will be quite sufficient.

The distribution pipes to the fittings may be ½ in. diameter.

It is important that a stop-cock be provided at the entry into the building and, if possible, at the entry of the pipe over the boundary of the property.

The stop-cock at the entry of the building should be below the lowest draw-off branch in order that the system may be emptied down if desired.

A ball-valve should be provided where the rising main enters the cistern (i.e. about 3 in. down from the top of the cistern). To prevent the overflowing of the cistern, a ¾-in. pipe should be provided so that when the water in the cistern reaches a certain level, it is allowed to pass through the overflow pipe and be discharged clear of the building.

Lead Pipes.—It is usual to service buildings with lead pipes, as this type of piping is adaptable and is more suitable for drinking water than galvanised iron. Lead is not affected by hard water, as an insoluble coating is formed on the inner surface which protects the lead.

Soft water has a small amount of action on lead, especially if the water is of an acid nature.

Joints in lead service pipes are usually "wiped," a process which produces a joint equal in strength to the pipe itself.

Vertical pipes should be held in position with pipe hooks unless they are of large diameter, when lead tacks should be soldered on to the pipe and fixed to the wall. It is advisable to support horizontal lead pipes on timber bearers to prevent the pipes sagging between the pipe clips.

Copper Pipes.—For internal services copper pipes are now often used, especially for distribution pipes; copper has many advantages over lead for this purpose. The ends of each length of pipe are threaded and connectors are used in making the joint between one length of pipe and the next. Where changes in direction and branch pipes are desired, specially made bends and tee-connections are used, thus eliminating hand-formed bends, branches and wiped joints.

The fixing of horizontal and vertical pipes is made by "holderbats," which consist of a metal ring with an arm attached for pinning into the brickwork.

The ring is in two halves which clip round the pipe, and the two halves are connected by bolts.

Soil Pipes.—The pipes which carry away waste water are called waste pipes, and those that carry away drainage refuse from the fittings are called soil pipes. Soil pipes from w.c.s are usually made of cast-iron and connected to the w.c. pan by a lead branch pipe. Cast-iron soil pipes are fixed to the external walls by "holderbats."

Waste pipes from lavatory basin and sink wastes may be formed in lead or galvanised iron.

Water-closet.—There are many types of water-closet on the market, but the main features of the fitting are the same. The material of which the fitting is made should be glazed earthenware, smooth and easily cleaned.

Every water-closet pan is provided with a trap outlet capable of containing sufficient water to prevent foul air from the soil pipe entering the compartment.

The pan is reduced in section until it reaches its lowest point, but from this point it remains constant.

The water discharged from the water waste preventer should flush the entire inner surface of the pan and be applied in sufficient force to flush the entire deposit away.

A water waste preventer fitting situated above or behind the pan provides the water for flushing the pan and should contain two gallons of water for each flush. See Fig. 101.

The flush pipe from a high-level type of water waste preventer should have a minimum number of bends, as these tend to reduce the force applied by the flush. The two main types of water waste preventers are the *siphonic valve*, which is operated by the force of the water creating siphonic action, and *siphon cisterns*, which are operated by the suction of the water which creates the siphonic action necessary to operate the flow of the water and are either the high- or low-level pattern.

When water-closets which are situated in a tier, that is, immediately over one another, in a building and discharging into the same soil pipe are flushed, the force of the falling water sets up siphonic action in the other traps which is due to a vacuum being formed in the down pipe. The result of this is to draw the water from the trap in the w.c. pan, which is situated below the one being flushed. To prevent this action taking place, an anti-siphonage pipe is introduced, one end of the pipe being connected to the pan at the top of the bend of the trap and the other end connected to the soil pipe just above the highest fitting.

The top w.c. fitting need not be provided with an anti-siphonage pipe.

Lavatory Basins.—These are made of glazed fireclay or earthenware and are irregularly shaped, usually shallow at the front and deepening at the back, the greatest depth being about 7 in.,

The surface of the fitting should be smooth so as to prevent the accumulation of dirt, and holes are usually provided in the fitting for the insertion of bib valves. There are usually perforations at the back, just below the top edge of the fitting, to which an overflow pipe may be connected so that any water passing through the perforation will run back into the waste pipe and be discharged.

A brass or chromium-plated connection to the waste pipe is fitted at the lowest part of the basin, and a plug and chain are provided. See Fig. 102.

Also a brass or chromium-plated S-trap, with a cleaning eye, is fitted to the basin waste to which the lead or copper waste pipe and trap is connected. If the basin is one of a tier, a puff pipe should be provided and fitted to the top of the trap so as to prevent siphonic action taking place when the water in the other basins is discharged. The trap may be made of lead or copper. Bib valves, which may be of brass, natural or chromium-plated, etc., are jointed to the service pipes; the stem of the tap is screwed by back-nuts to the basin.

Support for the basin may be of the pedestal type or it may rest on legs situated at the front of the basin, while the back of the basin is supported by means of brackets which are plugged to the wall. Cantilever brackets cut and pinned into the wall may be used, if desired.

Sinks may be obtained in fireclay, earthenware or polished non-corrosive metals. Sinks consist of a trough with a brass or chromium-plated waste connection fixed in the bottom of the fitting.

An overflow should be provided in the form of a weir situated near the top edge of the sink and a channel for the discharge of the water into the waste pipe. The waste and

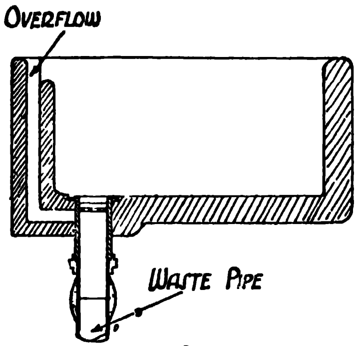
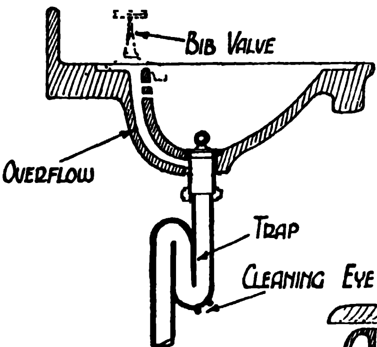


Fig. 103 Stoneware Sink



Lavatory Basin

Fig. 102

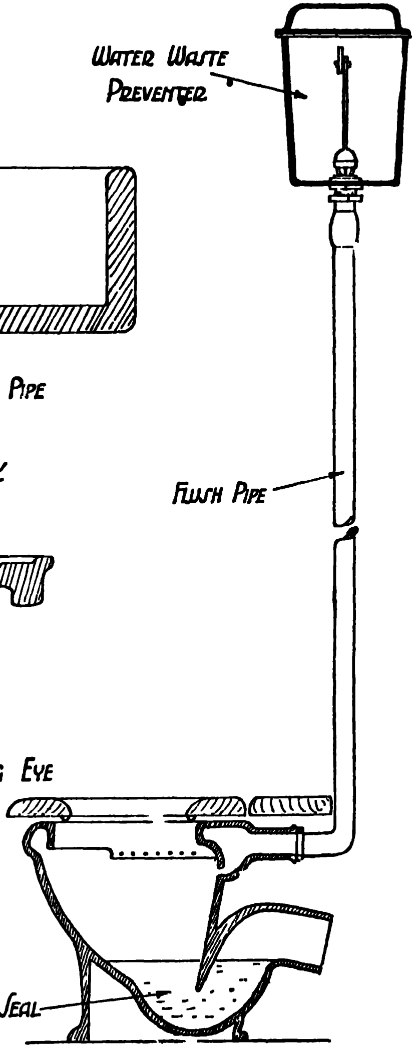


Fig 101 Water Closet

trap will be similar to that described for a lavatory basin. See Fig. 103.

Sinks may be supported on cantilever brackets cut and pinned into the wall. Bib valves may be fixed independently of the sink. Teak or metal draining boards may be provided to fit on to the sides of the sink.

External Plumbing

Gutters.—Where it is necessary to carry water away from the roofs, parapets, etc., a lead-lined gutter is usually the most suitable. It will consist of a long gutter provided with a fall in its length and constructed of boards and bearers dressed over with sheet lead.

Drips should be formed in the length of the gutter at intervals of not more than 9 ft. so as to provide the means for making joints between the sheets of lead.

Cast iron or asbestos cement are used for forming gutters at eaves, etc. They are made in various sections, such as half-round, box and ogee type.

The gutter is supported on gutter brackets which are screwed to the fascia board, one bracket at each joint. The brackets are fixed so that the gutter will have a slight continuous fall towards the outlets. Outlets and stopped-end fittings are fixed in the lengths of gutter at the required positions.

Pipes.—Cast-iron pipes are commonly used for rainwater disposal, but drawn lead or asbestos-cement pipes may be used. The diameter of the pipes for ordinary types of work is 3 in. or 4 in., but larger sizes can be obtained if the area of roof to be drained requires it. Pipes are manufactured in 6-ft. lengths. Cast-iron pipes are provided with spigot and faucet joints.

The fixing of cast-iron pipes may be made by ears formed on the pipes which are plugged and screwed to the wall. Holderbats may be used instead of ears, if desired.

Asbestos pipes are secured by means of holderbats, cut and pinned into the wall.

Gulley Traps.—Water from lavatory basins, sinks and gutters is collected at ground level in a fitting termed an open gulley containing a trap.

There are various types of gulley, many fulfilling some specific purpose, as, for example, grease-trap gulleys, etc. There are two main types of gulleys used for waste water: either the water is discharged into the gulley through the grating or discharged direct into the trap under the grating. The latter type of trap is called a *back-inlet gulley*, and is to be preferred to the first-mentioned type.

Soil pipes should not discharge their contents into gulleys but be connected direct to the drains without any interruption.

A cast-iron grating is provided on top of the gulley and the fitting should be partly encased in concrete, and a concrete bed provided as a seating for the trap.

CHAPTER X

PLASTER-WORK

Internal Plaster-work

The process of covering the internal wall surfaces of buildings with plaster may be carried out in two or three coats, the latter being known as Render, Float and Set, or Prick-up, Float and Set.

When described as Render, Float and Set, the term is applied to the covering of solid surfaces such as brick walls and block partition walls. The term Prick-up, Float and Set is applied to the process of covering wood or metal laths or expanded metal.

Materials.—Lime and sand, termed "coarse stuff," has been the material most commonly used for the covering of walls, but a mixture known as black mortar is frequently used for rendering. This latter material is composed chiefly of ashes or clinker, and ground in a mortar mill, during which process a small quantity of cement is added.

Coarse stuff is a combination of sand and lime and a small quantity of ox-hair (about 1 lb. to 3 cub. ft. of material) to act as a binding medium and to prevent cracks occurring when the material has dried out. After the rendering or pricking-up coat has been applied, the surface is scratched or combed to form a key for the floating coat.

The floating coat is a mixture of sand, lime and a small quantity of hair. This mixture is spread over the rendered wall surface and finished true to the screeds with a wooden tool, known as a float. The final and finishing coat is really a skimming of plaster. It may comprise a mixture of plaster of paris and sand, or lime putty and sand, or one of the "hard wall" plasters such as "Pioneer" or "Sirapite."

If grooved bricks have been used in the construction of the wall, as previously described, the recesses in the face

of the brickwork will form an additional key for the plaster.

When a hard surface is desired, such as at external angles and arrises, or where there is any likelihood of abrasion, Keene's cement or a similar type of hard-setting cement should be used. All external angles and arrises should be made up in two coats on a Portland cement backing.

Stud Partition Walls require the timber framework to be covered with wood or metal lathing so as to form the base for the plaster coating, unless the wall surface is made up with one of the many forms of plaster or wall boarding. A detail showing the construction of a wood stud partition wall is given in Fig. 104.

Lathing is used as the base for the support of the plaster-work on the soffit of timber-joisted floors, timber roofs, etc., unless the base is formed with plaster boards or hard-boards, because intermediate support for the plaster-work across the spaces between the joists is necessary.

The base may be carried out by nailing wood laths to the underside of the timber joists and at right angles to them.

The laths are either sawn or riven, the latter being considered the strongest, but the uneven nature of the laths will cause an irregular thickness for the plaster-work and consequently a more extravagant use of material.

Laths vary in length from 3 ft. to 4 ft. and are about 1 in. wide and are termed *single*, *lath and half*, or *double*, according to their thickness. The laths should be fixed so as to break joint at about every 3 ft. and placed about ¼ in. apart.

Expanded Metal Lathing consists of a metal mesh which is formed by stretching or expanding mild steel sheets to the form of a diamond-shaped mesh. This arrangement of the metal will form the key for the plaster and is often used in preference to wood laths as the base for plastered walls and ceilings.

Expanded metal may also be used as a self-centering

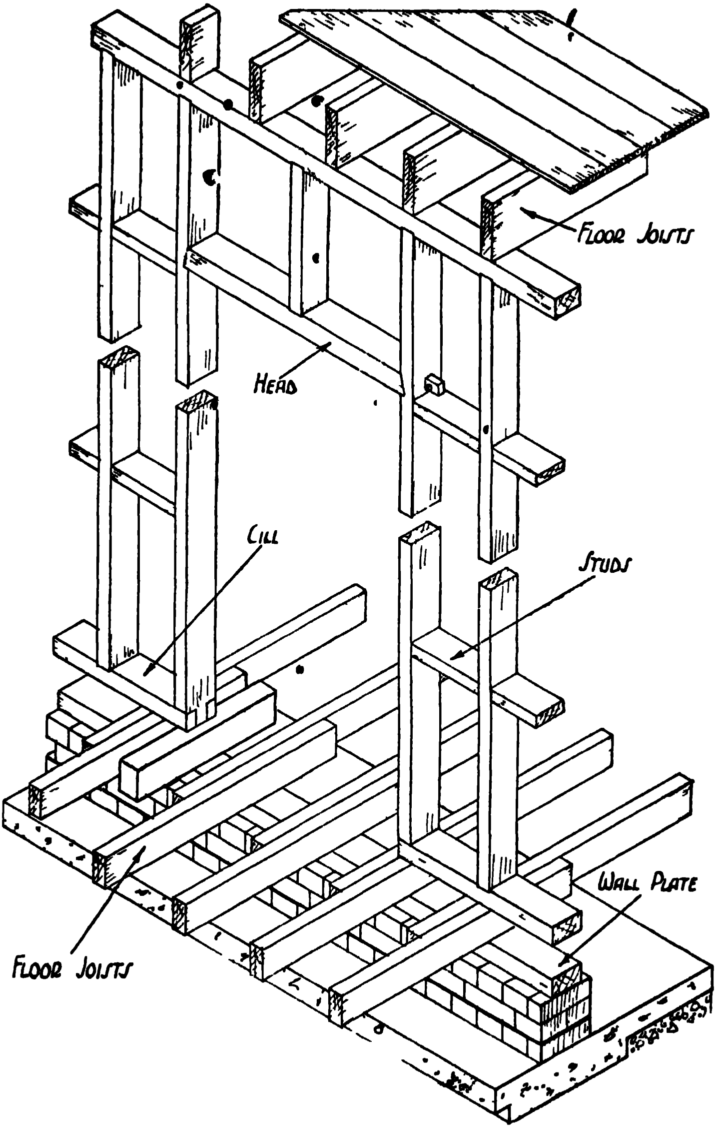


FIG 104 TIMBER STUD PARTITION

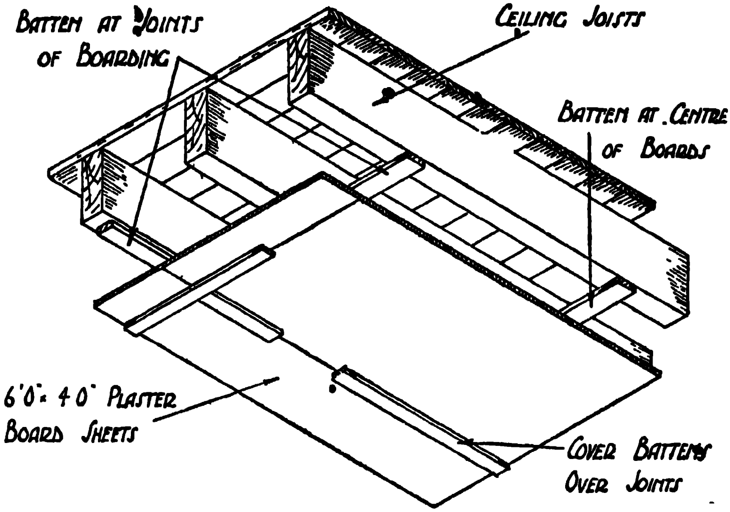


Fig 105 Ceiling Boarding

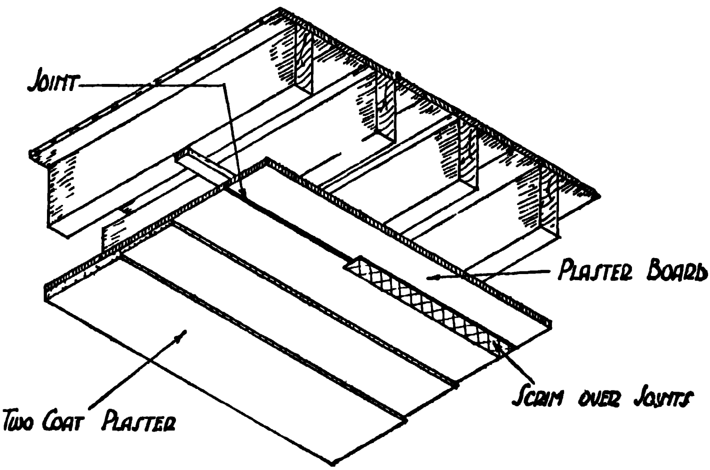


Fig. 106 Plaster Board Ceiling

device for the support of suspended ceilings, etc., in which case it is strengthened and supported by metal stiffening ribs.

Plaster Board.—Instead of forming a base with wood or metal laths, a base may be formed with pre-cast plaster boards. These boards are manufactured in sheets of varying sizes and thicknesses, and consist of a layer of plaster set on a scrim backing.

For constructional purposes the sheets are nailed to the framework of the wall or ceiling, the joint edges of the boards being rebated and fixed with open joints which are later filled in with plaster and covered with scrim. See Figs. 105 and 106.

The final surface coat for the ceiling is formed with a skimming or setting coat of plaster. The surfaces of plaster board should be roughened so as to provide an efficient key for the finishing coat.

Hard Board consists of sheets made of wood pulp or paper pulp that has been consolidated under pressure. These boards may be used to form wall surfaces and ceilings and may be obtained with either smooth or roughened surfaces. Smooth surface boards may be used to form the finished wall surface, the joints between the sheets being covered with wood battens. When the surface is required to be finished with plaster, roughened surface boards should be used, and the joints between the sheets covered with scrim before the plaster finishing coat is applied.

Scrim is a linen gauze which is used for uniting units of plaster-work.

Concrete Surfaces.—When it is required to form a plaster finish to the underside of concrete floor slabs, the surface of the concrete should be hacked or roughened while the concrete is "green," that is, before the final set has taken place.

The plastered surface may be formed by applying a skimming coat of hard wall plaster.

External Plaster-work

Stucco and Pebble Dash finishings are formed by applying a mixture of cement and sand to the surfaces of external walls of buildings, the required finish being obtained by the application of two coats. If stucco finish is desired, a first coat of cement and sand is applied to the wall surface and this is allowed to set; the finishing coat is then applied and finished off with a wood float, thereby producing a plain wall surface.

If pebble dash finish is desired, a thick coating of cement and sand, or lime and sand, is formed on the wall surface and finished by applying a mixture of pebbles, rough sand and small gravel. This mixture is thrown on to the wall while the coating is still wet so that the particles become partially embedded in the cement and sand.

Either of these types of wall finishings can be used as a means for excluding dampness when formed in conjunction with half-brick walls of buildings, such as garages, outhouses, etc.

CHAPTER XI

PAINTING AND GLAZING

Painting Woodwork.—Timber that is used for finished joinery work such as doors, etc., should be well seasoned, and the exposed surfaces finished clean and glass-papered to remove any slight irregularities. Should there be any knots showing on the surfaces they must be treated to prevent the resin content discolouring the finished paint-work. The normal knotting used is shellac which is applied in two coats, the first coat being glass-papered before the second coat is applied.

The joinery surfaces should first be primed with two coats of red lead primer to provide adhesion and also to prevent too great absorption of the paint by the woodwork. All nail heads should be sunk below the surface of the woodwork and the holes filled with putty. The process of filling up holes and crevices with putty is termed "stopping."

Having completed the preliminary operations to the surfaces of the new woodwork, the first or priming coat is applied and allowed to dry. The next and subsequent coats are then applied, the coats being named in order of sequence, the last coat being called the finishing coat.

Each coat, except the finishing coat, should be rubbed down with glass paper as the work proceeds. The number of coats to be applied will depend on the nature of the work, but for the woodwork surfaces of ordinary buildings, three coats of oil colour for external woodwork and two coats of oil colour for internal work should be sufficient. The finishing coat may have a high gloss or a matt finish. Should the latter be desired it may be applied in the form of a "flatting" coat before the finishing coat has dried.

The surfaces of hardwoods are not usually painted, the finished surfaces being oiled and french or wax polished.

Painting Metalwork.—All ironwork surfaces should be painted, as the coating of paint will prevent rust forming and therefore act as a preservative. Before commencing painting, the surfaces of all ironwork should be cleaned and all mill scales or any oil or grease that may have come in contact with the metal removed. A priming coat of red oxide should then be applied and well worked into the surfaces of the metal.

After allowing for the priming coat to dry, successive coats of oil-colour with a white lead base may be applied.

Where galvanised iron is required to be painted, the iron should be painted with a coat of "Mordaunt" solution so as to neutralise the effect of the galvanising.

Painting Walls.—Plastered walls should be well rubbed down and all holes, etc., stopped with Keene's cement. The surfaces should be painted with a coat of size to prevent excessive absorption by the wall material, after which a red lead priming coat may be applied, followed by oil-colour paints in the required number of coats.

Glazing

Materials.—Sheet Glass is formed by subjecting sand, soda, lime and certain other ingredients to a temperature of approximately 1,500° C. The glass is made into sheets by being taken in bulk from the heating tank and passed through a drawing kiln from which it is drawn up in a continuous ribbon and allowed to cool off in an annealing tower.

Sheet glass is made in various thicknesses and described in terms of ounces per sq. ft., namely, 18 oz., 24 oz., 26 oz., 32 oz., $\frac{1}{12}$ in., $\frac{1}{10}$ in., $\frac{1}{8}$ in., $\frac{5}{32}$ in. respectively. Sheet glass is generally used for glazing purposes; it is fire-finished and, in consequence, the two face surfaces are not quite parallel or perfectly flat. There are three qualities: *ordinary glazing quality*, *selected glazing quality*, *special selected quality*. 18-oz. sheets are commonly used for glazing purposes, but for additional safety 24 oz. is recommended.

Polished Plate Glass is made similar to sheet glass, and its chemical composition is practically the same, but its surfaces are mechanically ground and polished.

It is allowed to pass through water-cooled steel casting rollers where it is rolled into a continuous ribbon, the width of which depends upon the amount of feed to the rollers.

The ribbon passes from the rollers through a long horizontal annealing lehr, but when the ribbon leaves the lehr, it has rough surfaces which must be removed by grinding.

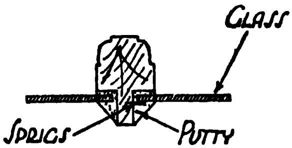
The thickness of plate glass ranges from $\frac{1}{8}$ in. to $1\frac{1}{4}$ in., but $\frac{1}{4}$-in. plate is most commonly used.

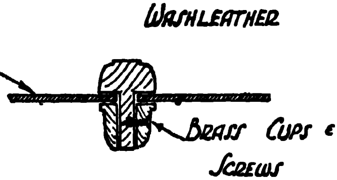
Rolled Glass is made by the extension of the sheet between two rollers. There are three types of rolled glass: Rough-cast, Cathedral and Wired.

> **Rough-cast Glass.**—The surfaces are plain or ribbed.
>
> **Cathedral Glass** has one side impressed with patterns of various depths and form. The patterns for the imprints are formed on the sheets from the patterns cut in the surface of the rollers. Thicknesses range from $\frac{1}{8}$ in. to $\frac{1}{4}$ in.
>
> **Wired Glass** may be either rough-cast or cathedral glass in which wire netting is inserted in the sheets during the process of rolling.

Obscured Glass.—Where it is required to have a translucent glass, the surface may be removed by a process of roughening, either by sand-blasting or by the application of acids. Among the special types of obscured glass may be mentioned Arctic, Cathedral, Diamond, etc.

Wood Sashes.—Glass may be fixed in wood sashes by placing putty in the rebate made for the glass. The putty will act as a bed and allow for any unevenness in the frame. "Sprigs," which are headless steel brads, are used as a means for fixing the glass while a bevelled putty fillet is formed to cover the joint and add support for the glass. See Fig. 107.





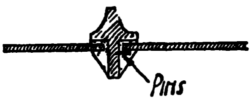
WITH PUTTY

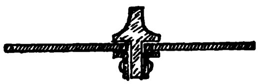
WITH WOOD BEADS

GLAZING TO WOOD SASHES

FIG 107

FIG. 108





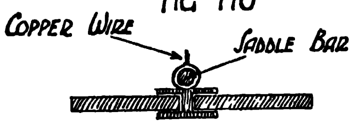
WITH PUTTY

WITH METAL BEADS

GLAZING TO METAL SASHES

FIG 109

FIG 110



LEAD CAMES

FIG 111

SADDLE BAR TO LEAD CAMES

FIG 112

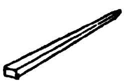


FIG 113

SPRIGS

BRASS CUP & SCREW

An alternative method of fixing the glass is by using wood beads. The glass is bedded in on a pad of wash-leather which is placed in the rebate. The glass is held in position by wood beads which are fastened to the frame with screws which have brass cups. The danger from this type of glazing is that any twisting of the frame may cause the glass to crack. See Fig. 108.

Metal Sashes.—The glass may be fixed in the same manner as for wood, and steel pins are used in the same manner as sprigs for securing the glass. A bevelled putty fillet is formed to cover the pins and to provide additional support for the glass, as shown in Fig. 109. Metal or wood fillets may be used to secure the glass in lieu of putty, the fillets being screwed to the metal frame. See Fig. 110.

Lead Lights consist of small pieces of glass which are formed into a sheet by being fitted in lead strips called "Cames," which are of H-section and fit over the edges of the glass. The lead is beaten over close to the surface of the glass so as to secure the glass. See Fig. 111.

Where large areas of this type of glazing are required the *Cames* are strengthened by the addition of saddle bars, which are fixed to the inside of the panes at various intervals and fastened to the *Cames* by copper wire, as shown in Fig. 112. The completed pane may be bedded in the sash or frame in the same way as for ordinary glazing, but when putty is used, a small proportion of red lead should be added in order that it may adhere to the lead *Cames.*

Sketches of a sprig and a brass cup and screw are given in Fig. 113.

CHAPTER XII

SOLID FLOORS

Reinforced Concrete Floors

This type of floor may be constructed *in situ*, that is, constructed by being poured on to formwork which has been erected on the site and in the required position.

The formwork for the concrete having been erected, the steel reinforcement is placed in its correct position and held by binding wire. The concrete is poured and well tamped around the reinforcement and into the formwork in order to ensure that no air holes have been allowed to remain and that a proper adhesion between the concrete and the steel has been effected.

The formwork, or shuttering as it is often called, must be erected and constructed in such a manner that it will be rigid and strong, because it will be required to carry the whole weight of the concrete until it is set. The whole area of the floor may be boarded over at the correct level, the boarding being supported on timber joists which in turn are supported by props, or struts, from the floor beneath, as shown in Fig. 114.

These props or struts may be made either of wood or of metal, there being several patent types of adjustable props for the purpose. Wood props are wedged up from the floor to the underside of the joists, the wedges being inserted to assist in the easing of the formwork when striking.

The formwork timber may be rough, or wrot, to give a finished surface to the underside of the concrete floor slab; in either case the timber should be well wetted before the concrete is poured to prevent the concrete adhering to the boards.

Concrete floor slabs may be supported on the walls by being recessed into the brickwork and they may receive intermediate support across the span by the introduc-

tion of beams, composed of reinforced concrete or of steel.

Filler-Joist Floors

Instead of forming a reinforced concrete floor slab, small R.S.J.s may be placed about 3-ft. centres across the span and the concrete floor slab formed around the steel work. This type of floor is called a filler-joist floor.

It is necessary to erect some form of formwork to support the concrete while it is wet, since the spaces between the joints are to be filled in with concrete, and the concrete casing around the main beams, poured at the same time as the concrete for the floor slab, will require supporting.

The formwork, or centering, may be suspended from the joists by the use of stirrups, which clip around the supporting timber bearers and also around the small steel joists, the boards and beam formwork being supported on the beams, as shown in Fig. 115.

Pre-cast Concrete Floors

Floors that are made with pre-cast concrete units have many distinct advantages over those constructed *in situ*, but the chief advantage is the elimination of formwork, because the units are supported on the walls or on the steelwork.

The concrete units are placed in position to cover the whole of the floor area and the concrete slab is formed on the top surface of the units.

Floors made of pre-cast units are suitable for ordinary buildings and steel frame structures but not for reinforced concrete structures, as the monolithic character of the latter is largely dependent upon the floors, walls and pillars being formed as a single unit.

Pre-cast concrete units are made in various forms, the design of each having some special feature incorporated, but the chief principle in the design of the units is the primary one of self-centering. While such floors are usually

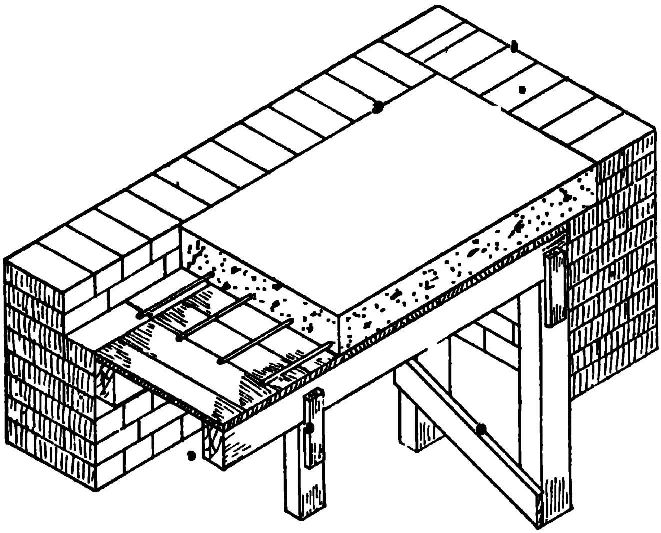


FIG. 114 SUSPENDED CONCRETE FLOOR SLAB

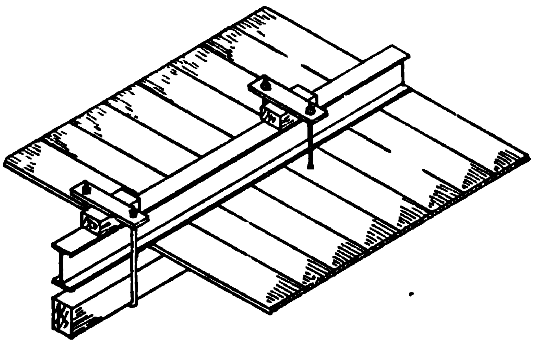


FIG. 115 SUSPENDED CENTERING TO CONCRETE FLOOR

erected in conjunction with steel beams which are spaced to suit the length of the unit to be used, they can be used very economically in the construction of floors for domestic buildings. Rod reinforcement may be used between units to provide a binding and to give continuity to the units. After the units have been placed in position and grouted with concrete to form a homogeneous and continuous floor slab, a layer of concrete is poured on top of the units to give a flat surface and to receive the floor finishing.

Pre-cast unit floor slabs are also preferred because they are comparatively light in weight and conformable to the strength required.

Another type of self-centering floor is made up with hollow clay tiles. This type of floor is erected in conjunction with steel beams, the tiles being laid with or without rod reinforcement which acts as a binder.

After the tiles have been laid the joints are grouted and concrete fill or a screed is poured on the top surface of the tiles. The tiles in this instance act as the permanent centering for the floor slab. The soffit of pre-cast and hollow tile floors may be plastered to produce an even surface and to cover the joints between the units.

Concrete Roofs.—The same construction as used for floor slabs may be adopted for flat roof slabs, but a lighter type of construction may be preferable because flat roofs are not usually intended to be weight carriers. The concrete used as a filling may have pumice as an aggregate so as to reduce the weight of the slab. The screed formed on the top of the slab must be laid to falls so that the inclination of the surface of the roof covering will cause the water to be thrown off the roof surface and be discharged into the gutter.

Bituminous felt, asphalte or a similar type of material should be laid on the top of the screed to form the roof covering.

CHAPTER XIII

CONSTRUCTION OF A GARAGE

Methods and Material

The following sub-headings give the approximate order of construction for a small garage to a house. Certain trades and operations may be required to be interchanged to suit local conditions and the delivery of materials.

Site Clearing.—All old material, existing sheds, etc., should be removed, but any suitable material which can be used may be cleaned and restacked.

Setting-Out.—The area for the surface excavation and the wall foundations will require marking out. After the surface soil or top spit has been removed, pegs may be driven into the ground at the corners of the building site, and a cord stretched between the pegs to give the line for the excavations for the foundation trenches.

The cord, which is stretched tightly between the pegs, will act as a guide for the purpose of excavating.

Care should be taken with preliminary setting-out operations, as the whole of the subsequent work will depend on the accuracy with which it is carried out. The position of the brickwork, including cross walls and angles, is marked on the foundation concrete and these lines will indicate the position of the walls for the guidance of the bricklayer.

Excavation.—It is necessary to remove the top vegetable soil to a depth of about 6 in. The site of the building should be levelled either by further surface digging or by filling up all hollow portions with hardcore. The trenches for the walls and the inspection pit should be excavated and the bottom of the trenches trimmed. If the soil is light it may be necessary to use planking and strutting at the sides of the trenches to keep the earth from slipping into the excavation, but in this example the

excavation for the wall foundations will not be deep, therefore very little timbering will be required.

Concrete Foundations.—When the trenches have been excavated to the correct depth and width, and the bottom trimmed, the concrete slab for the wall foundation is placed in position. Clean, "all in" ballast may be used with Portland cement, in the proportion of 6 to 1 for this purpose, care being exercised to ensure that the top surface of the concrete is level and at its correct depth.

The depth of the top surface of the concrete can be tested by measuring down from a datum or fixed point, but it is preferable to adopt a system of pegs for this purpose. The pegs are driven into the ground at the bottom of the excavated trench and the tops of the pegs are kept to the level required for the concrete, which is placed in position and the top surface finished off level with the tops of the pegs.

Hardcore.—A 4-in. bed of hardcore should be laid over the site to receive the concrete surface layer. The hardcore should be well packed and consolidated.

Drains.—The trench for the drain may be excavated before or after the walls are built; the 4-in. salt-glazed stoneware drain pipes may then be laid on a 4-in. concrete bed and benched up with concrete along the sides of the pipes.

The excavated material should be back-filled and the material well rammed as soon as the concrete has set and the drain tested.

Concrete Surface Layer.—The 4-in. bed of concrete composed of "all in" ballast and Portland cement in the proportion of 6 to 1 can now be laid on the hardcore, together with the concrete forming the bottom and sides of the inspection pit. The concrete for the pit can be placed in position at the same time as the floor is laid, but it will be necessary to provide vertical formwork to hold the concrete in position at the sides of the pit. If the pit is to be concreted after the concrete floor is laid it will

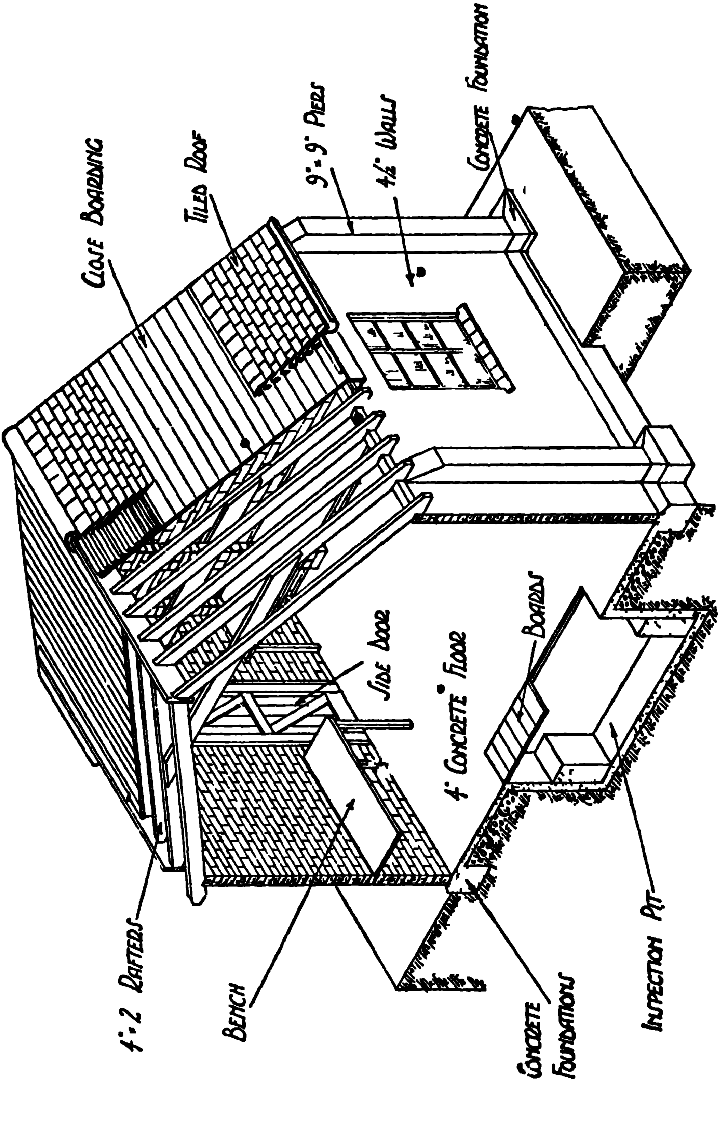


FIG 116 GARAGE – ISOMETRIC SKETCH

be necessary to fix boarding clear of the sides of the pit, the top edge of the boarding being placed level with the top of the concrete floor slab. The boarding, when placed in this position, will act as a screed for levelling the top surface of the floor slab.

The top surface of the concrete layer may be trowelled smooth and laid to a slight fall so that any water that may find its way to the floor of the garage will be drained away to the gully outside the building.

Brickwork.—The next operation is to build up the brickwork to the height of the damp-proof course. As the outside wall surfaces are to be rough cast, the bricks may be of the grooved Fletton type, the grooved face being placed toward the exterior of the building to receive the external cement rendering.

After the damp-proof course has been laid, the brickwork should be continued up to eaves and the window and door openings set out as the work proceeds. The door and window frames may be fitted later or, if desired, the frames may be fixed in position and the brickwork built around them.

For the garage, the interior face of the brickwork may be pointed with a neat flush joint as the work proceeds. The walls being of half-brick construction, the building of the brickwork will be stretcher bond and the piers will be built and bonded into the walls as they are constructed.

Damp-proof Course.—Two courses of slates bedded in cement may be laid on the brickwork at a height of 6 in. above the ground level to provide a damp-proof course, or bituminous felt may be used, if desired.

Lintols.—These are of the reinforced concrete type, and they may be either pre-cast or cast *in situ*. If pre-cast they should be built in by the bricklayer as the wall reaches head height, and as the wall is ready to receive them.

This procedure will obviate expensive cutting and pinning after the brickwork is completed. If cast *in situ*, the bricklayer should leave a pocket in the brickwork

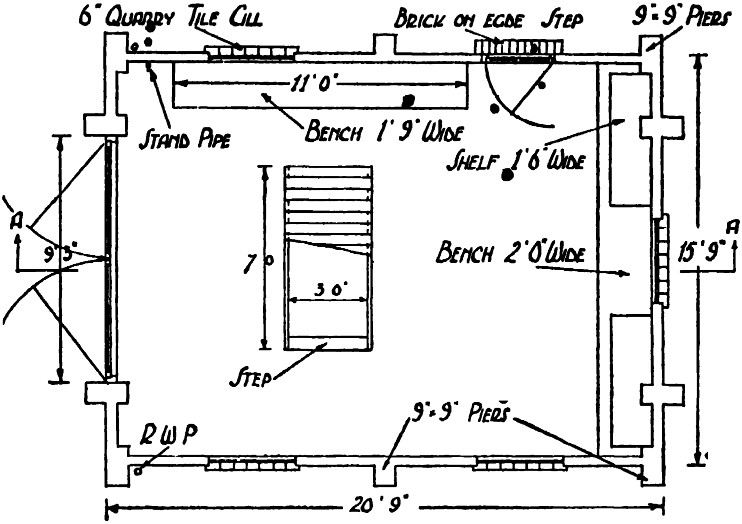


Fig. 117 Garage Plan

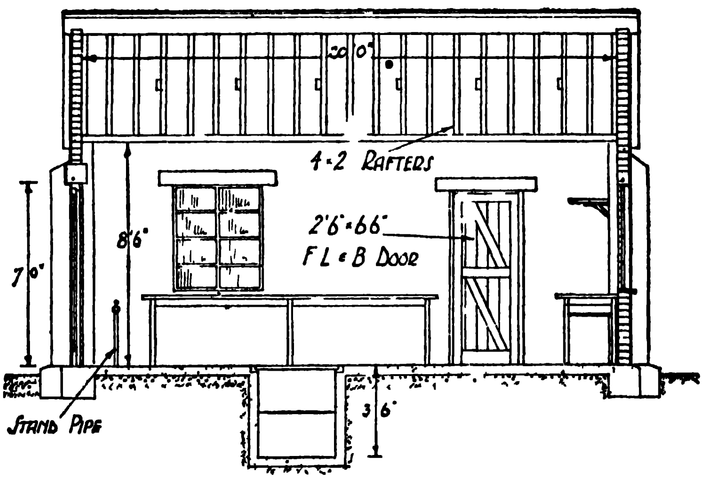


Fig 118 Garage - Section A-A

at head height to receive the ends of the lintol. To form a cast *in situ* lintol the erection of shuttering comprising two sides and soffit boards will be necessary, the concrete being poured into the formwork after the reinforcement has been fixed in position.

The brickwork above lintol height should not be built until the lintol is sufficiently strong to support the weight of the superimposed load.

Roof Timbers.—When the brickwork has been completed up to eaves level and gable height, the roof timbers may be fixed, commencing with the wall plates, which are bedded on the wall. The ridge board is next fixed on the top of the gable walls. The rafters are then cut to length, bird's-mouth jointed to fit over the wall plate and jointed against the ridge board, and spiked at each end.

Tiling.—The laying of the roof boarding and fixing the tile battens should be the next operation in order to complete the tiling. The covering of the roof will enable work to be continued inside the structure should inclement weather stop external work. The tiling should be commenced at eaves with a double course of tiles and continued up the roof slope until the ridge is reached. The tiles should be nailed every third or fourth course and torched with hair mortar if close roof boarding is not used.

Steel Window Frames.—In cheap construction these are built in as the brickwork is erected, but in better-class work the lugs of the window frames are pinned into the brickwork and run in with red lead and the frame bedded in cement and pointed both sides.

Door Frames may be built in as the brickwork is built, or fixed in afterwards. In the latter case, the frames should be plugged to the brickwork and the joint between the brickwork and the frame pointed with cement and sand or covered with a bead. When the doors are hung care must be taken to ensure that both hinges are carrying the weight of the door equally.

Tile Sill.—The brickwork should have a groove left

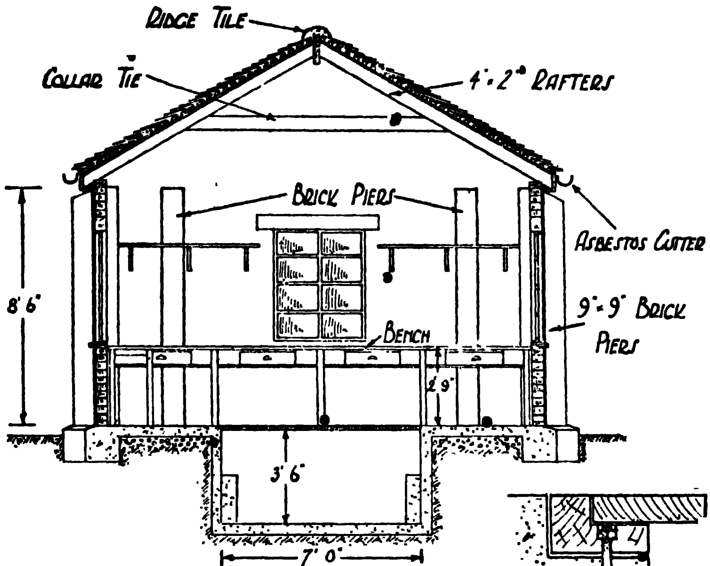


FIG. 119 GARAGE - SECTION 'BB'

DETAIL OF COVER TO PIT

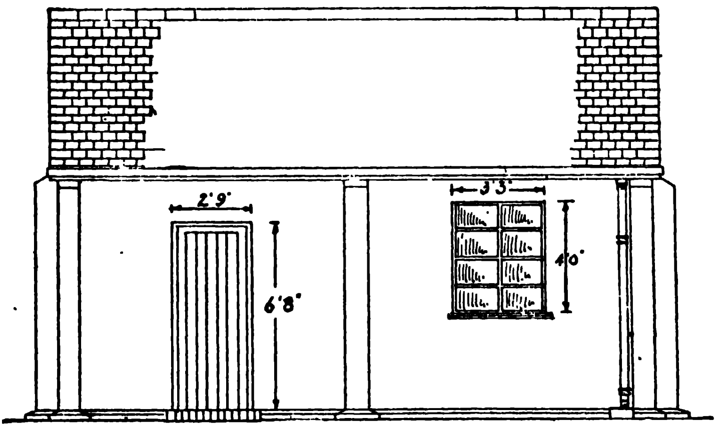


FIG. 120 GARAGE - SIDE ELEVATION

in each jamb for a width of about 3 in. to receive the tile sill, which may be bedded in cement and sand and formed in two courses breaking joint and bedded in an inclined position. The joints should be pointed with a neat flush joint.

Wall Covering.—The walls being only half-brick in thickness, it will be necessary to render the external face of the brickwork with cement and sand (1 to 3) in two coats, the second coat being a foundation to receive a rough cast finish. Should pebble dash finish be required, small gravel or spar chippings are thrown against the "green" rendering, the exposed particles being allowed to remain as the finished surface.

Fascia Boards.—To provide a finish to the ends of the rafters which project beyond the face of the brickwork at the eaves, and also to provide a support for the gutter, a fascia board is fixed to the ends of the rafters as shown.

Soffit Board.—Should it be required to close the eaves on the underside of the projecting rafters, soffit boarding may be fixed to bearers, one end of which rests upon a wood fillet, which is plugged to the brickwork, while the other end of the bearer is nailed to the feet of the rafters. The soffit boarding should be tongued into a groove formed in the back surface of the fascia board.

Rainwater Gutter.—A 6-in. half-round eaves gutter may be fixed to the fascia board by means of metal gutter brackets. The two types of material in common use for gutters are cast iron and asbestos. The latter is cheaper and quite serviceable, provided it is not knocked or subjected to rough usage, and care must be taken that ladders are not allowed to rest against it.

Gutters are supplied in lengths of 6 ft., not including the joint. The position of the gutter should be marked on the fascia board, a slight fall being allowed in the length, and the brackets screwed on to the fascia board or roof timbers at 6-ft. centres. Where the rainwater pipe meets the gutter a special length of gutter, with an outlet

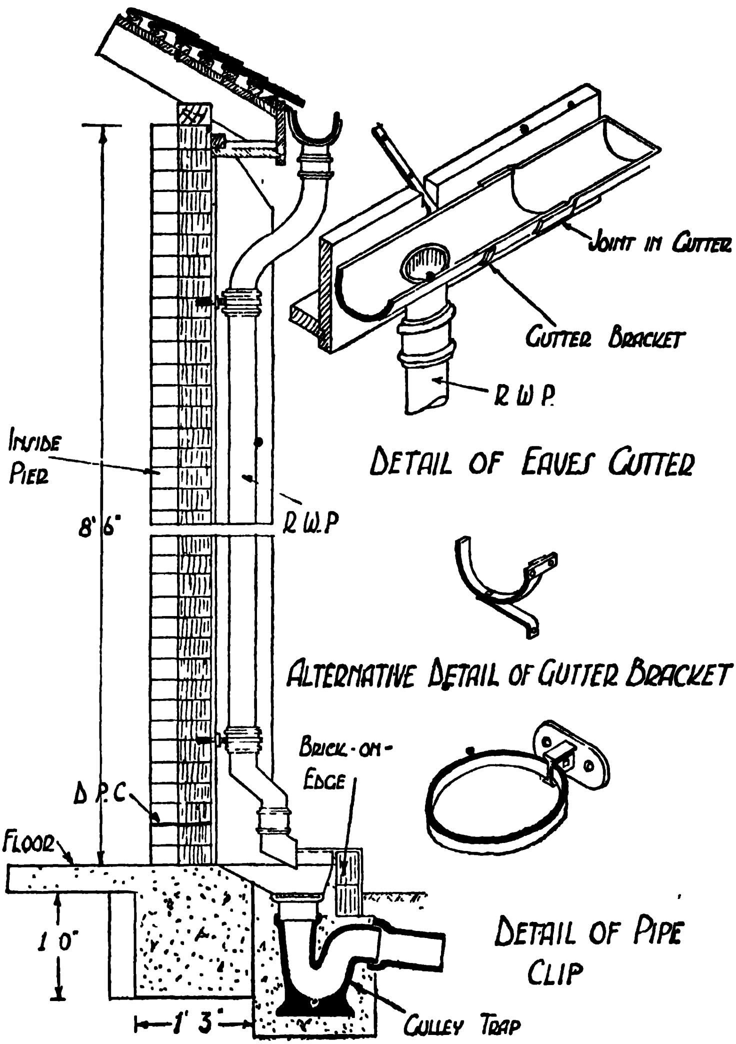
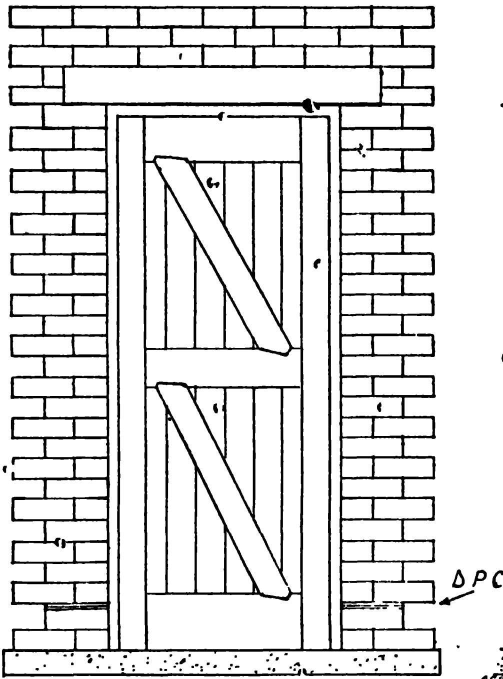

Joint in Gutter
Gutter Bracket
R W P.
Detail of Eaves Gutter
Inside Pier
8' 6"
R W.P
Alternative Detail of Gutter Bracket
Brick-on-Edge
D P.C
Floor
1 0"
1' 3"
Detail of Pipe Clip
Culley Trap

FIG 121



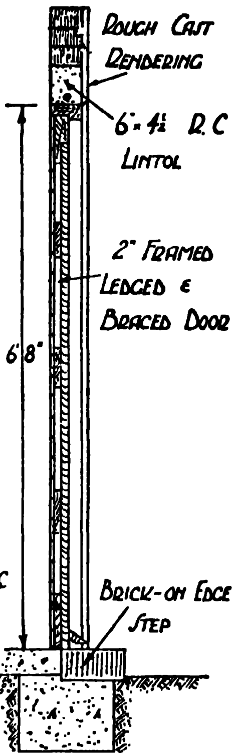
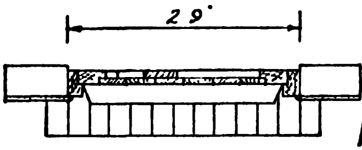


Fig. 122
Elevation of Side Door

Section Fig. 123



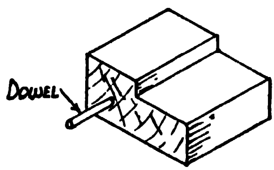


Fig. 125 Detail at Foot of Frame

Fig 124 Plan

nozzle attached, must be fitted. At the end of a run of gutter a special stop-end fitting should be used.

Rainwater Pipes.—3-in. rainwater pipes will be sufficient to carry the water away from the roof, and these should be of the same material as used for the gutter.

The pipes are fixed in position by means of "holderbats" which are plugged and screwed to the brickwork. The pipes can be obtained in 6-ft. lengths, and should have one holderbat fitting to each length of pipe and situated just below the collar. When it is required to bring the pipe away from the face of the wall to the front of the eaves, a swan-neck fitting may be used. When the rainwater discharges into an open gulley, a "boot" or "shoe" fitting is fixed at the lowest end of the pipe.

Glazing.—The main carcase work having been completed, the glass may be fixed in the metal sashes. The sizes of the openings must be measured and an allowance made of $\frac{1}{8}$ in. in width and height. Glass may be bought cut-to-size, or it may be cut on the site. The panes should be bedded in the frames in putty and steel pins inserted in the holes provided for them in the metal sashes. The pins are intended to hold the glass in position, but they should, however, be kept away from the glass and the putty placed over them and trimmed off. The frames and sashes should be primed before glazing.

Fittings.—The internal fittings such as benches, shelving, etc., should be made up, framed together, plugged and screwed to the brickwork and all the ironmongery of the doors and fittings should now be fixed in position.

Painting.—The whole of the woodwork which is to be painted should first be knotted and a thin priming coat applied before the joinery is fixed and another coat applied after fixing. All surfaces should be stopped after priming is dry. Three coats of oil paint should be applied to all external woodwork and two coats to internal woodwork. Metal sashes should have a priming coat and two coats of oil paint to all internal and external surfaces. The

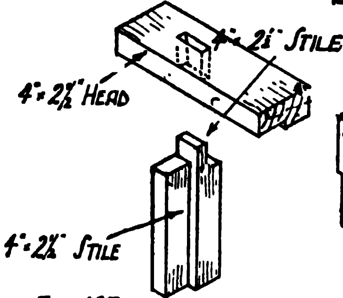
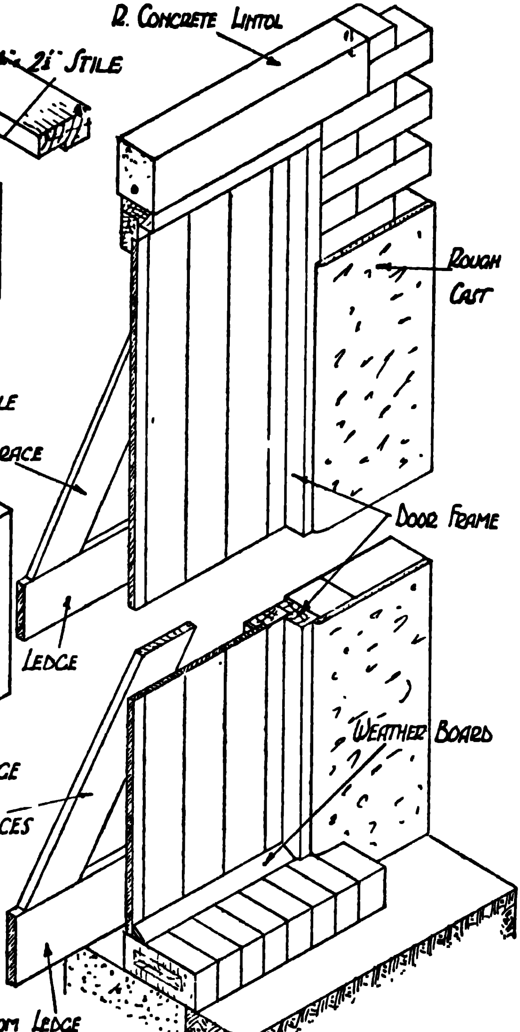


Fig. 127
Detail of Joint
Between Head & Stile



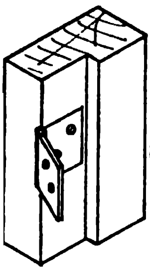


Fig. 128
Detail of Butt Hinge

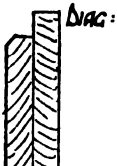


Fig. 129
Detail of Weather Board

Fig. 126

Garage - Detail of Side Door

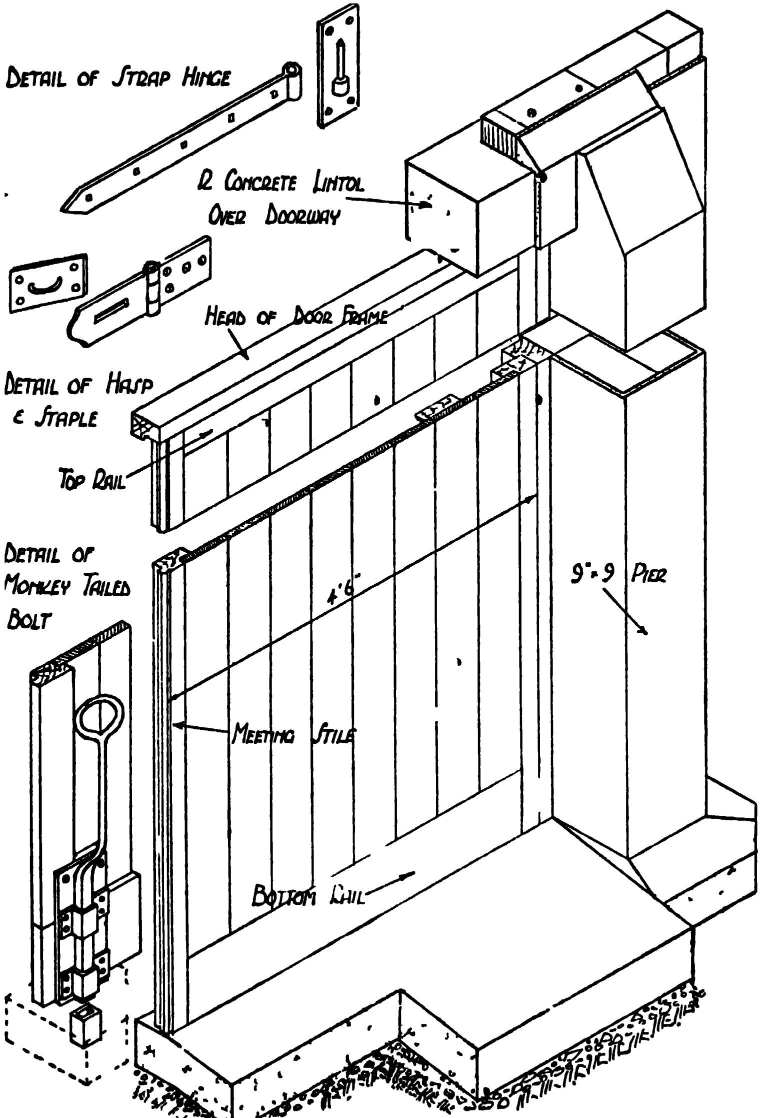


Fig. 130 Garage - Main Entrance Doors

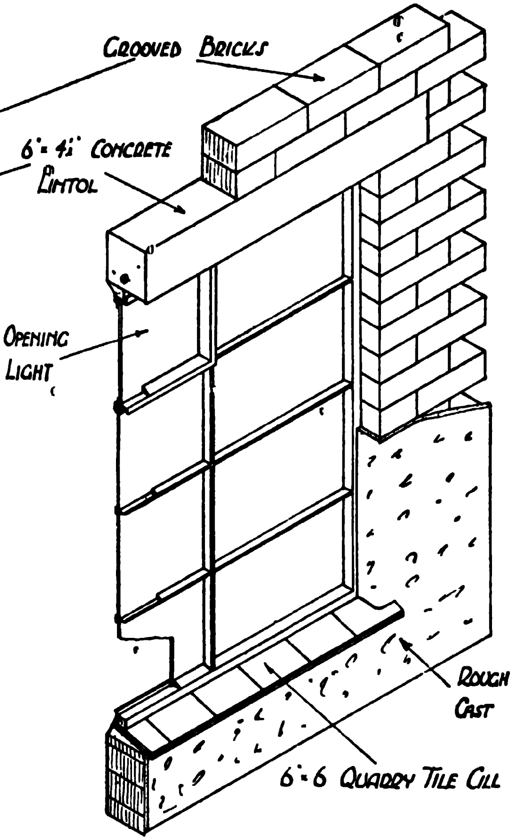


Fig. 131

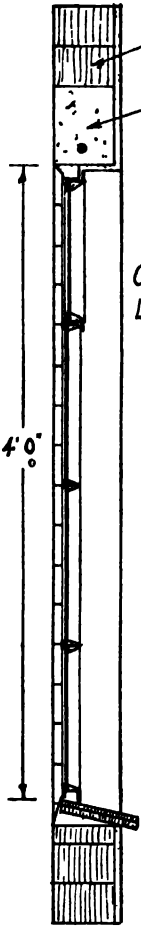


Fig. 132

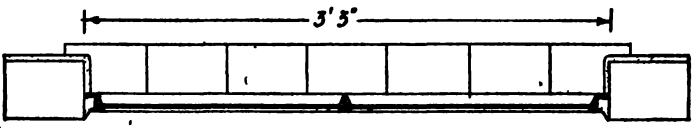
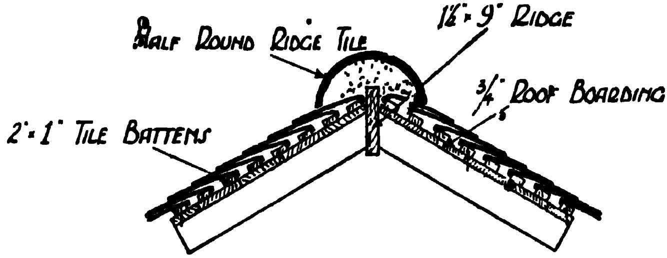


Fig 133 Garage Detail of Windows



Garage - Detail at Ridge

Fig 134

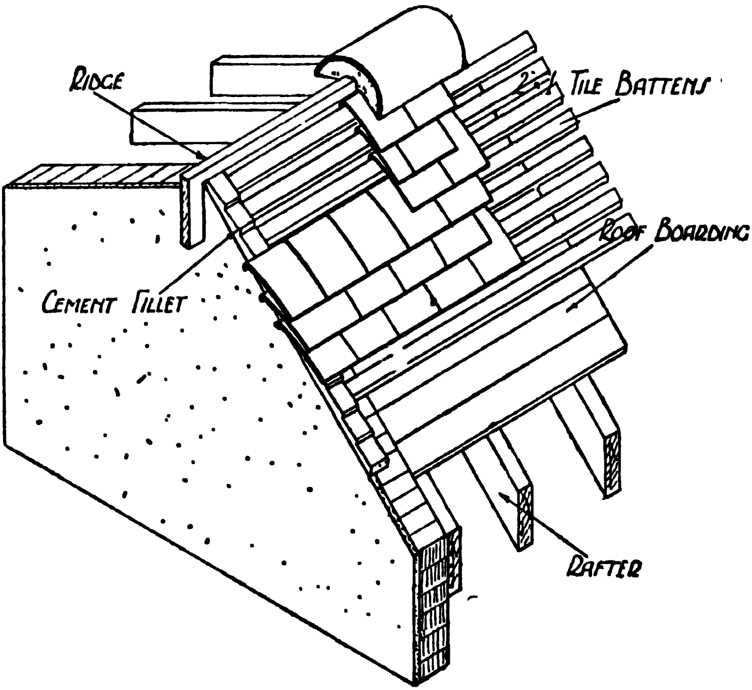


Fig 135 Garage - Detail of Gable End

exposed surfaces of the roof rafters may be left unpainted, but if it is desired to paint them two coats of wood preservative solution may be applied.

The gutter and rainwater pipes should be primed and two coats of oil paint applied.

The shelving should have the front edge, underside and brackets painted, while the bench and drawers may be left unpainted, if desired. The brickwork surfaces, if desired, may be painted with two coats of washable distemper.

Duct Boards over Inspection Pit.—These boards should be made to span across the short side of the pit and they should comprise $1\frac{1}{4}$-in. deal boarding. The cover may be made in three removable sections or each board may be fitted separately. If in three sections, the boards to each section should be framed together by fixing two deal battens across the boards on the underside. These battens should be slot-screwed to allow for any movement in the boards due to expansion and contraction. The duct boards should rest on timber sole pieces anchored or bolted to the concrete floor, the latter being rebated to receive the ends of the duct board.

Stand Pipe.—This may be fixed in position by the use of holderbats cut and pinned to the brickwork. The bib tap fitting should have a hose union fitting.

Storm-water Manholes.—The pit for the manhole should be excavated with an allowance all round of 6 in. in order that the outer face of the brickwork may be rendered in cement. The bottom of the pit should be trimmed to receive the 4-in. concrete bed slab and, when the concrete has set, the position of the brickwork for the sides of the manhole may be set out and built, the external face of the brickwork being rendered as the work proceeds. After the first few courses of the brickwork have been built a half-round channel should be formed in cement and sand at the bottom of the manhole, or a glazed channel may be bedded, the surfaces at the sides of the

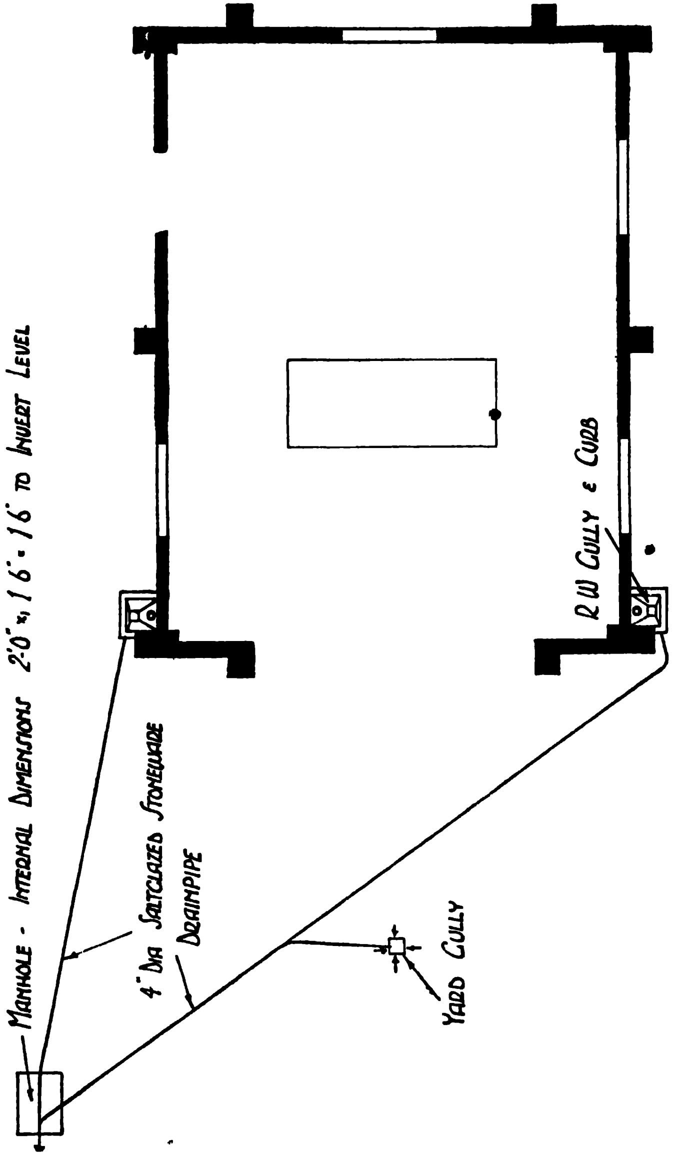
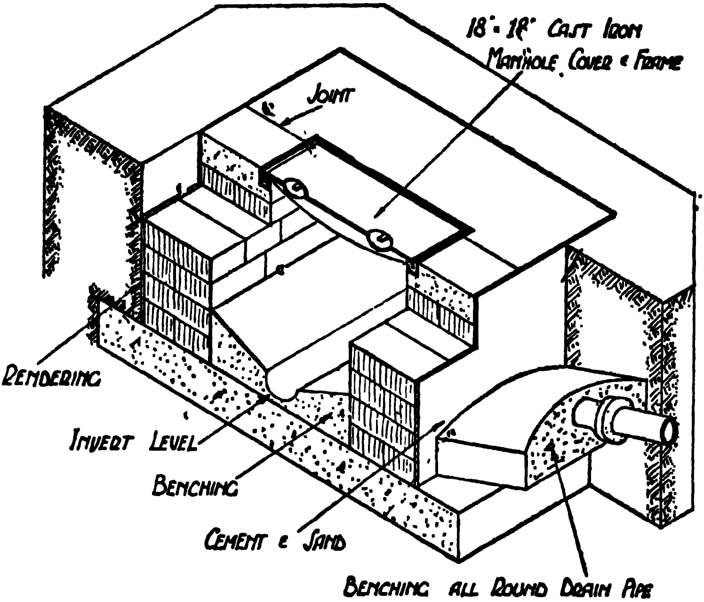
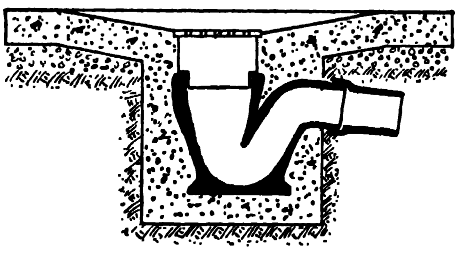


FIG. 136 GARAGE SURFACE WATER DRAINAGE



GARAGE - DETAIL OF SURFACE WATER MANHOLE

FIG. 137



DETAIL OF YARD GULLEY TRAP

FIG 138

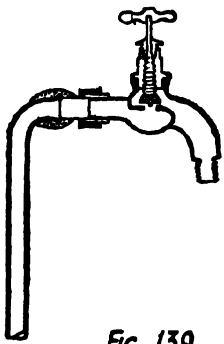


FIG. 139

DETAIL OF STANDPIPE

channel being benched up 3 in. above the top edge of the channel.

The branch channels should be formed at the same time, care being taken that all channel surfaces are finished smooth. The drain pipes discharging into the manhole should be built in as the work proceeds.

When the brickwork has been raised to the required height a cover slab should be placed on the top of the manhole. This cover slab may be formed in pre-cast concrete, and should be perforated and rebated to receive the manhole cover frame. The frame should be set in neat cement.

The invert of the drain, namely the level of the lowest part in the half-round section of the channel, having been ascertained beforehand, and the manhole having been built to give the invert that level, the drain pipes between the two manholes, or from the gulleys to the manholes, may now be laid. A trench is excavated, giving the required width and depth, the bottom being trimmed to receive the 4-in. concrete bed. After the concrete bed has set, the stoneware drain pipes may be laid in position and jointed, the spigot end of the pipes being set in the direction of the flow and the joints formed in neat cement.

If the drain is situated under the road or carriageway the pipes should be completely surrounded with concrete so that any weight that might have to be taken by the pipes will not damage them. When the length of drain has been completed and the pipes jointed the trench should be filled in with the excavated material. This process is termed "fill-in and ram."

CHAPTER XIV

QUANTITIES FOR THE GARAGE

The following outline of operations necessary in the construction of a garage is given to assist those who desire to undertake the task for themselves. One of the greatest difficulties which is met with at the outset, is the ordering of materials. To overcome this difficulty it is necessary to become acquainted with the method of analysing the quantity of materials which will be required to complete the structure. To guess the quantities required, unless wide experience has been had in such matters, is to run the risk of ordering too little, or, what is equally as bad, ordering too much, material. To order too little material entails the extra expense of ordering a small quantity to complete, while to order too much material entails the extra expense of the materials left over at completion of the structure.

It is not proposed in this chapter to lead the reader through the intricacies of quantity surveying, but to give an outline of a simple form of measurement, abstracting and a final bill for ordering. For those who desire a fundamental knowledge of the basis of quantity surveying, reference should be made to the volume in this series entitled "*Quantity Surveying*." In this volume the processes are fully outlined, together with worked-out examples.

The various materials are measured and tabulated as shown under the heading of "Quantity of Materials" or "Taking Off" as it is termed in quantity surveying. The materials of like nature are gathered together in the form of an abstract, and from this the final bill for ordering is obtained.

The reason for "taking off" all the items in the building and then abstracting is to obtain the total quantity of

materials of any particular type. This process will enable the materials to be ordered together and thus save expense. It should be borne in mind that, although the quantities for the garage are small in comparison with larger types of construction, a saving may be made by bulk ordering, as suppliers may be able to deliver the materials in full loads, thus reducing transport charges.

QUANTITIES OF MATERIALS
(Taking off)

1. PLANKING AND STRUTTING

Timber struts required for formwork assumed sufficient for planking and strutting.

2. HARDCORE

ft.	in.	ft.	in.		ft.	in.
				Internal length . . .	20	0
				Less projection of concrete foundation 2/5¼″ . .		10½
					19	1½
				Internal breadth . .	15	0
				Less projection as last 2/5¼″		10½
					14	1½
19	2			Under floor slab and pit		
14	2					
	4	90	6			
		90	6	(Carried to Abstract B)		

Note.—Hardcore under yard paving not measured

3. CONCRETE IN FOUNDATIONS
(1 : 6 Mix)

	ft.	in.
Length of garage . .	20	9
Breadth of do. . . .	15	9
2/	36	6
Girt of external face of wall	73	0
Deduct passings at angles 4/4½″	1	6
Girt of centre line of brick wall and concrete foundations	71	6

(*continued*) **Concrete in Foundations**

	ft. in.	ft. in.		ft. in.
			Width of pier . . .	9
			Projection of concrete foundation 2/5¼" . . .	10½
				1 7½
			Girt of external face of wall	73 0
			Add passings at angles 4/5¼"	1 9
			Girt of centre line of chamfer to top of concrete foundation	74 9
			Add chamfer to piers 10/2/9".	15 0
			Girt of chamfer . .	89 9

	71 6 1 3 1 0	89 5	To walls
10/	1 8 9 1 0	12 6	To external piers
4/	5 5 1 0	8	To internal piers
4/	1 8 5 1 0	2 9	Ditto
	89 9 5 3	9 4	To chamfer
		114 8	(Carried to Abstract A)

Entrance door . . .	9 3
Side door	2 9
	12 0

12 0 5 3	1 3	*Deduct* chamfer to doors
	1 3	(Carried to Abstract A)

4. CONCRETE SURFACE LAYER
(1 : 2 : 6 Mix)

	ft.	in.	ft.	in.	
	20	9			
	15	9			
		4	108	11	To floor slab
10/	1	8			
		9			
		4	4	2	To external piers
2/	7	8			
		4			
	3	6	17	11	To sides of pit
2/	3	0			
		4			
	3	6	7	0	Ditto
	9	3			
		9			
		4	2	4	Between entrance piers
2/	3	0			
		6			
	1	9	5	3	To step in pit
			145	7	(Carried to Abstract A)

5. CONCRETE LINTOL
(1 : 2 : 4 Mix)

Note.—Assumed to be cast *in situ*

	ft.	in.	ft.	in.	
	10	9			
		9			
		9	6	1	To main entrance
	3	9			
		5			
		6		9	To side entrance
4/	4	3			
		5			
		6	3	7	To windows
			10	5	(Carried to Abstract A)

(*continued*) **Concrete Lintol**

		ft.	in.
MAIN ENTRANCE			
Length of lintol	. .	10	9
Less cover at ends 2/1½"	.		3
		10	6
Add hooks 2/6"	. .	1	0
		11	6
SIDE ENTRANCE			
Length of lintol	. .	3	9
Less cover at ends	. 2/1½"		3
		3	6
Add hooks 2/3"	. .		6
		4	0
WINDOWS			
Length of lintol	. .	4	3
Less cover at end 2/1½"	.		3
		4	0
Add hooks 2/3"	. .		6
		4	6

	ft.	in.	ft.	in.		
2/	11	6	23	0	¾" mild steel reinforcing rods	Main entrance
	4	0	4	0		Side entrance
4/	4	6	18	0		Windows
			45	0	(Carried to Abstract E)	

6. FORMWORK

	ft.	in.	ft.	in.	
2/	7	0			
	3	6	49	0	1" wrot deal boarding as formwork to sides of pit
2/	3	0			
	3	6	21	0	
			70	0	(Carried to Abstract H)

(*continued*) **Formwork**

	ft. in.	ft. in.		ft. in.
6/	3 0			
	3			
	3	1 2	Sawn deal struts	
		1 2	(Carried to Abstract L)	
			MAIN ENTRANCE	
			Width of soffit . . .	9
			Add thickness of two vertical boards	2
				11
			SIDE ENTRANCE	
			Width of soffit . . .	4½
			Add ditto. . . .	2
				6½
			MAIN ENTRANCE	
	10 9			
	9	8 1	1″ wrot deal boarding as formwork to concrete lintols	Internal face
	9 3			
	9	6 11		External face
	9 3			
	11	8 6		Soffit
			SIDE ENTRANCE	
2/	3 9			
	6	3 9		Faces
	2 9			
	7	1 7		Soffit
			WINDOWS	
4/2/	4 3			
	6	17 0		Faces
4/	3 3			
	7	7 7		Soffit
		53 5	(See note, Abstract H)	

7. BRICKWORK

	ft. in.	ft. in.		ft. in.
			Height of wall at gable end .	12 9
			Height of wall at eaves	8 6
			Difference in height at gable end	4 3
	71 6 8 6	607 9	Half brick wall	External wall of garage
2/½/	15 9 4 3	66 11		Gable ends
		674 8	(Carried to Abstract C)	

	ft. in.	ft. in.		
	9 3 7 0	64 9	*Deduct* half brick wall	Main entrance opening
	2 9 6 8	18 4		Side entrance opening
4/	3 3 4 2	54 2		Window opening
	10 9 9	8 1		Main entrance lintol
	3 9 6	1 10		Side entrance lintol
4/	4 3 6	8 6		Window lintol
		155 8	(Carried to Abstract C)	

(*continued*) **Brickwork**

	ft. in.	ft. in.		
10/	9			
	8 0	60 0	One brick wall in external piers	
		60 0	(Carried to Abstract C)	
4/	5			
	8 6	14 2	Half brick wall in internal piers	
4/	9			
	8 6	25 6		
		39 8	(Carried to Abstract C)	

8. BRICKWORK SUNDRIES

	ft. in.	ft. in.		
2/4/	3 6	28 0	6″ × 6″ quarry tile sill	
		28 0	(Carried to Abstract F)	
	71 6	71 6	Slate damp-proof course in two layers of stout slates 4½″ wide	
		71 6	(Carried to Abstract G)	
	9 3	9 3	*Deduct* last . . .	Main Entrance
	2 9	2 9		Side Entrance
10/	9	7 6		Piers
4/	5	1 8		Piers
		21 2	(Carried to Abstract G)	
8/	1 6	12 0	*Add* stout slate damp-proof course in two layers 9″ wide to piers	
2/	1 2	2 4		
		14 4	(Carried to Abstract G)	
	3 3			
	9	2 5	Brick-on-edge step	
		2 5	(Carried to Abstract C)	

9. ROOF TIMBERS

	ft.	in.	ft.	in.		
2/21/	9	9				
		4				
		2	22	9	Fir in roof	Rafters
6/	11	0				
		6				
		2	5	6		Collar Ties
	21	6				
		9				
		1½	2	0		Ridge
2/	20	9				
		4				
		3	3	6		Wall plates
			33	9	(Carried to Abstract L)	
2/	20	0				
	9	6	380	0	¾″ Deal boarding to roof	
			380	0	(Carried to Abstract L)	
					Length of slope 9′ 6″	= 114″
					Gauge of tiles 4″ Number of battens required =	114″ ÷ 4″
						= 29
2/29/	20	6	1189	0	1″ × 2″ Tiling battens rift sawn	
			1189	0	(Carried to Abstract L)	
2/	20	9				
		4	13	10	½″ Portland cement and sand (1 : 3) in bedding plate	
			13	10	(Carried to Abstract D)	
2/	20	6	41	0	2½″ × 1″ Deal tilting fillet	
			41	0	(Carried to Abstract L)	

10. TILING

	ft. in.	ft. in.	
2/	21 6 9 6	408 6	Tiling to roof with $10\frac{1}{2}'' \times 6\frac{1}{2}''$ tiles laid to a 4" gauge and nailed every fourth course with composition nails
		408 6	(Carried to Abstract M)
2/	21 6	43 0	Extra for double course at eaves
		43 0	(Carried to Abstract M)
	21 6	21 6	Half-round ridge tiles
		21 6	(Carried to Abstract M)
4/	9 6	38 0	Extra for tile and a half at verge
		38 0	(Carried to Abstract M)
	21 6 1 0 4	7 2	Portland cement and sand (1 : 4) in bedding half-round ridge tiles
		7 2	(Carried to Abstract I)

11. EXTERNAL RENDERING

		ft. in.
Length of garage . .		20 9
Breadth of do. . . .		15 9
	2/	36 6
		73 0
Add angles of rendering $4/\frac{3}{4}''$		3
		73 3

(*continued*) **External Rendering**

	ft.	in.	ft.	in.		
	73	3				
	8	2	598	3	¾" Portland cement and sand in rendering to brick walls with rough cast finish	External wall of garage
2/½/	15	9				Gable ends
	4	6	70	11		
10/2/		9				
	8	0	120	0		Piers
10/		9				
	1	0	7	6		Top of Piers
			796	8	(Carried to Abstract I)	
	9	3				
	7	0	64	9	*Deduct* last . . .	Main Entrance
	2	9				
	6	8	18	4		Side Entrance
4/	3	3				
	4	2	54	2		Windows
			137	3	(Carried to Abstract I)	

		ft.	in.
Height of side door .	2/	6	8
		13	4
Width of do. . . .		2	9
Girt		16	1
Height of window .	2/	4	2
		8	4
Width of do. . . .		3	3
Girt		11	7

	ft.	in.	ft.	in.		
	16	1				
		1	1	4	*Add* last in reveals . .	Side door
	9	3				
		3	2	4	*Add* last in soffit . .	Main Entrance
4/	11	7				
		3	11	7	*Add* last in reveals . .	Window
			15	3	(Carried to Abstract I)	

(*continued*) **External Rendering**

	ft. in.	ft. in.	
½/	10 9		
	3		
	3	4	3″ × 3″ Triangular fillet in Portland cement and sand (1 : 4) over main entrance
		4	(Carried to Abstract I)

12. DOORS AND FRAMES

			ft. in.
1	1	Pair 2″ framed ledged and braced doors 9′ 0″ × 6′ 10½″ overall with 2″ × 4″ hanging stiles rebated for boarding 2″ × 4″ twice rebated meeting stiles 2″ × 4″ rebated head rail 1″ × 6″ ledge and 1″ × 9″ bottom rail the whole framed together and with 1″ tongued grooved and V-jointed boarding screwed on and including 2″ × 3″ weatherboard screwed on (Carried to Final Quantities)	

		ft. in.
Height of door overall	2/	7 0
		14 0
Width of do. . . .		9 3
		23 3
Add horns, 2/3″ . .		6
		23 9

23 9	23 9	4″ × 3″ Deal wrot rebated frame
	23 9	(Carried to Abstract N)

(*continued*) **Doors and Frames**

	ft. in.	ft. in.		ft. in.
	1	1	2" Framed, ledged and braced door 2' 6" × 6' 6" with 2" × 4" hanging stiles rebated for boarding 2" × 4" rebated head 1" × 6" ledge and 1" × 8" bottom rail the whole framed together and with 1" tongued grooved and V-jointed boarding screwed on and with 2" × 3" weatherboard screwed on	
			(Carried to Final Quantities)	
			Height of door . . 2/	6 7½
				13 3
			Width of do. . . .	2 9
				16 0
			Add horns, 2/3" . .	6
				16 6
	16 6	16 6	4" × 2½" Deal wrot rebated frame	
		16 6	(Carried to Abstract N)	
2/2/	1	4	Wrot iron dowels 2" long	
		4	(Carried to Final Quantities)	
2/2/3/	1	12	Wrot iron cramps ¼" × 1" and 9" long one end bent and screwed to deal frame other end split and built into brickwork	
		12	(Carried to Final Quantities)	
	23 3 4	7 9	Bed and point frame in Portland cement mortar, 1" thick (1 : 3) . .	Main Entrance
	16 0 4	5 4		Side Entrance
		13 1	(Carried to Abstract I)	

13. JOINERY

EXTERNAL

	ft.	in.	ft.	in.	
2/	21	6	43	0	1¼" × 9" Wrot deal fascia grooved for soffit board
2/2/	1	0	4	0	
			47	0	(Carried to Abstract O)
2/	21	6	43	0	10" × 1¼" Wrot deal soffit board tongued one edge for fascia
			43	0	(Carried to Abstract O)
2/	21	6	43	0	2" × 2" Wrot deal bearer
2/9/		8	12	0	
			55	0	(Carried to Abstract O)

INTERNAL

	ft.	in.	ft.	in.	
2/	5	0			
	1	6	15	0	1" Wrot deal cross-tongued shelving
			15	0	(Carried to Abstract O)
	11	0			
	1	9	19	3	1¼" Wrot deal cross-tongued bench top
	15	0			
	2	0	30	0	
			49	3	(Carried to Abstract O)
16/	2	8	42	8	2" × 2" Wrot deal legs and bearers to benches
2/	10	8	21	4	
	15	0	15	0	
3/	1	6	4	6	
5/	1	9	8	9	
			92	3	(Carried to Abstract O)

(*continued*) **Joinery**

	ft. in.	ft. in.	
	15 0	15 0	1″ × 9″ Wrot deal front to bench
		15 0	(Carried to Abstract O)
			The following in No. 4 deal drawers :—
4/	2 0 7	4 8	1″ Wrot deal front
		4 8	(Carried to Abstract O)
4/2/	1 9 7	8 2	¾″ Wrot deal sides and back
4/	2 0 7	4 8	
		12 10	(Carried to Abstract O)
4/	1 11 1 8	12 9	Three-ply ¼″ thick to bottom
		12 9	(Carried to Abstract O)
4/4/	6	8 0	1″ × 1″ Triangular deal blocking fillet
		8 0	(Carried to Abstract O)
4/4/4/	1	64	1″ × 1″ × 2″ ditto under bottom = 10′ 8″ feet run of 1″ × 1″ fillet (Carried to Abstract O)
4/2/	1 9	14 0	1½″ × 2″ Wrot deal bearers
		14 0	(Carried to Abstract O)
4/2/	1 9	14 0	2″ × 1″ *Hardwood* runner
		14 0	(Carried to Abstract O)
4/2/	1 9	14 0	1″ × ½″ *Hardwood* fillet
		14 0	(Carried to Abstract O)

(End of No. 4 drawers)

(*continued*) **Joinery**

	ft. in.	ft. in.	
2/	3 6	7 0	4″ × 2″ wrot deal post for cabin hooks
		7 0	(Carried to Abstract L)
2/	6 9 1 6	1 2	Concrete (1 : 6) around post
		1 2	(Carried to Abstract A)
2/	1 0 1 6	3 0	Two coats wood preservative to post
		3 0	(Carried to Abstract Q)

14. IRONMONGERY

Note.—All ironmongery to have screws supplied. All the following quantities for ironmongery carried direct to Final Quantities.

			DOUBLE DOORS AT MAIN ENTRANCE
2/	1	2	Pairs 18″ steel strap hinges
	1	1	12″ Stout jointed locking bar and 4-lever padlock with 2 keys
	1	1	18″ Monkey-tailed bolt with socket for letting into concrete
	1	1	9″ Barrel bolt and socket for screwing to deal
2/	1	2	Set of 4″ cabin hooks and eyes
			SIDE ENTRANCE
	1	1	Pair 4″ steel butt hinges
	1	1	4-Lever rim lock and set of bakelite furniture
			SHELVING AND FITTINGS
6/	1	6	14″ Japanned iron shelf brackets
4/	1	4	4″ Brass drawer pulls
24/	1	24	2″ × 2″ × ¼″ steel buttons for bench top

15. COVER TO INSPECTION PIT

	ft. in.	ft. in.	
	7 0 3 4	23 4	1″ Wrot deal cover to pit
		23 4	(Carried to Abstract L)
2/	7 0	14 0	2″ × 4″ Wrot deal rebated plate
		14 0	(Carried to Abstract L)
2/3/	1	6	½″ diameter bolts 4″ long ragged at one end for building in and threaded other end including nut and washer (Carried to Final Quantities)
2/	1	2	4″ Brass lifting rings (Carried to Final Quantities)
2/	7 0 4 2	9	*Deduct* concrete (1 : 2 : 6) to rebated in pit for deal plate
		9	(Carried to Abstract A)

16. STEEL WINDOWS

4/	1	4	Standard metal windows in 8 squares overall size 3′ 3″ × 4′ 0″ with one top square top hung to open outwards including casement stay and fastener and with lugs riveted on for building into brickwork (Carried to Final Quantities)

17. RAINWATER GOODS

	ft. in.	ft. in.	
			EAVES GUTTERS
2/	21 6	43 0	6″ Half-round asbestos cement eaves gutter
		43 0	(Carried to Abstract P)

(*continued*) **Rainwater Goods**

	ft. in.	ft. in.	
2/2/	1	4	Extra for stop ends (two ends for spigot and two for socket) (Carried to Final Quantities)
2/	1	2	Extra for nozzle with outlet for 4″ rainwater pipe (Carried to Final Quantities)
2/6/	1	12	Galvanised iron gutter brackets for screwing to deal (Carried to Final Quantities)
			RAINWATER PIPE
2/	9 4	18 8	4″ Asbestos cement rainwater pipe
		18 8	(Carried to Abstract P)
2/	1	2	Extra for swan-neck bend 15″ projection (Carried to Final Quantities)
2/	1	2	Extra for plinth bend 6″ projection (Carried to Final Quantities)
2/	1	2	Extra for rainwater shoes (Carried to Final Quantities)
2/2/	1	4	Galvanised iron pipe clips in one piece for plugging and screwing to brickwork (Carried to Final Quantities)

18. PLUMBING

All the following quantities for plumbing carried direct to Final Quantities :—

		ft. in.
Through wall	. .	4½
Up wall	. . .	3 0
		3 4½

	ft. in.	ft. in.	
	3 5	5	½″ Galvanised wrot iron pipe (water quality)
	1	1	½″ Galvanised iron pipe clip
	1	1	½″ Brass bib tap, with nozzle for hose union
2/	1	2	½″ Galvanised wrot iron elbow

Note.—The pipe has only been taken to outside face of wall of building.

19. MANHOLES

The following in No. 2 manholes size, 2′ 0″ × 1′ 6″ internally :—

	ft.	in.	ft.	in.		ft.	in.
					Internal length . . .	2	0
					Brick wall 2/9″ . . .	1	6
					Projection of concrete foundation bed 2/6″ .	1	0
						4	6
					Internal width . . .	1	6
					Brick wall 2/9″ . .	1	6
					Projection, as last 2/6″ .	1	0
						4	0
2/	4	6					
	4	0					
		4	12	0	Concrete bed (1 : 6 mix)		
			12	0	(Carried to Abstract A)		
2/	3	6					
	3	0					
		3	5	3	Concrete cover slab (1 : 2 : 4)		
			5	3	(Carried to Abstract A)		
2/	1	6					
	1	6					
		3	1	2	*Deduct* perforation in last for manhole cover and frame		
			1	2	(Carried to Abstract A)		
					Top of benching from concrete bed . . .		6
					Lowest point (i.e. invert level) to concrete bed . .		1
							7
					Average . .		3½
2/	2	0					
	1	6					
		4	2	0	Concrete in benching (1 : 2 : 6)		
			2	0	(Carried to Abstract A)		
					Brickwork internal width .	1	6
					Brickwork overall length .	3	6
						5	0

(*continued*) **Manholes**

	ft. in.	ft. in.		ft. in.
			Girt of brick sides to manhole measured on the centre line . . .	10 0
2/	10 0 1 3	25 0	1 Brick wall in hard stock bricks	
		25 0	(Carried to Abstract C)	
			Outside length . . . Outside width . . .	3 6 3 0
			2/	6 6
			Girt of external rendering .	13 0
2/	13 0 1 3	32 6	½" Portland cement and sand (1 : 3) in rendering	
		32 6	(Carried to Abstract I)	
			Perforation— Length . . . . Width	 1 6 1 6
			2/	3 0
			Girt around perforation	6 0
	13 0 3	3 3	Formwork to side of cover slab	
	6 0 2	1 0	Ditto to perforation	
		4 3	(See note on Abstract H)	
	6 0	6 0	1½" × 1½" Wrot deal in formation of rebate to cover slab	
		6 0	(Carried to Abstract L)	
2/	1	2	18" × 18" cast-iron manhole cover and frame	
		2	(Carried to Abstract J)	

20. DRAINAGE

	ft. in.	ft. in.		
	26 0	26 0	4″ "Best Quality" salt-glazed stoneware drainpipe	From rainwater gulley
	4 0	4 0		Yard gulley
	16 0	16 0		Rainwater gulley
		46 0	(Carried to Abstract K)	
			Note.—Drainage beyond manhole has not been included	
3/	1	3	4″ Bends (Carried to Final Quantities)	
	1	1	4″ Access bend (Carried to Final Quantities)	
	1	1	4″ Junction (Carried to Final Quantities)	
2/	1	2	Trapped gulley with 4″ outlet and 6″ × 6″ cast-iron grating (Carried to Final Quantities)	
	1	1	Yard trapped gulley, with 4″ outlet and 9″ × 9″ cast-iron grating (Carried to Final Quantities)	
	15 0 1 4 4	6 8	Concrete (1 · 6) in bed under 4″ drainpipe	
2/½/	15 0 7 3	2 2	Ditto in three-quarter benching to each side of 4″ drainpipe (taken as two average triangles)	
		8 10	(Carried to Abstract A)	
	29 6 1 4 4	13 1	Concrete (1 : 6) in bed under 4″ drainpipe	
⅔/	29 6 1 4 8	17 6	Ditto in benching all round (assumed to be parabolic in section)	
		30 7	(Carried to Abstract A)	

(*continued*) **Drainage**

	ft. in.	ft. in.		ft. in.
3$\frac{1}{7}$/	2			
	2			
	29 6	2 7	*Deduct* 4″ diameter drainpipe	
		2 7	(Carried to Abstract A)	
2/	1 6			
	1 0			
	1 9	5 3	Concrete (1 : 6) in surround to trapped gulley	
	1 9			
	1 4			
	1 6	36		
		8 9	(Carried to Abstract A)	
			Curb to gulley . . .	1 5
				1 0
				9
			2/4½″	9
				3 11
2/	3 11			
	9	5 11	Half brick curb to gulley	
		5 11	(Carried to Abstract C)	
			Render to curb—	
			Outside face . . .	9
			Top face . . .	4½
			Inside face . . .	2
			Passings . . 2/¾″	1½
				1 5
2/3/	1 0			
	4			
	2	4	Portland cement and sand (1 : 4) in dishing to gulley	
2/	3 11			
	1 5			
	1	11	Ditto in rendering to curb	
		1 3	(Carried to Abstract D)	
8/	1	8	Lb. yarn gasket for jointing	
			(Carried to Final Quantities)	

21. GLAZING

The following quantities for glazing carried direct to Final Quantities :—

4/3/	1	12	Panes 24 oz. clear sheet glass size $11\frac{3}{8}''$ × $18\frac{1}{4}''$ cut to size
4/	1	4	Ditto size $10\frac{3}{8}''$ × $17\frac{1}{8}''$ cut to size
4/4/	1	16	Panes obscured glass size $11\frac{3}{8}''$ × $18\frac{1}{4}''$ cut to size (for lower panes)
8/	1	8	Lb. glazing putty

22. PAINTING

The following quantities for painting carried to Abstract Q :—

	ft.	in.
Inside length . . .	20	0
Inside width . . .	15	0
2/	35	0
Girt	70	0

	ft.	in.	ft.	in.		
	70	0				
	8	6	595	0	Clearcolle and once distemper fair face brickwork	Internal face of wall
2/½/	15	0				
	4	3	63	9		Gable end
4/2/		5				
	8	6	28	4		Piers
			687	1		
	9	3				
	7	0	64	9	*Deduct* last . . .	Main entrance
	2	9				
	6	8	18	4		Side entrance
4/	3	3				
	4	2	54	2		Windows
			137	3		

(*continued*) **Painting**

	ft.	in.	ft.	in.		ft.	in.
	9	3					
		3	2	4	*Add* last to soffit of lintol		
2/		1					
	7	0	1	2	Ditto to reveal of Main Entrance door		
4/2/	11	7					
		2	15	5	Ditto to reveals of windows		
			18	11			
					SIDE ENTRANCE DOOR		
	2	6					
	6	6	16	3	Knot prime stop and two coats of oil-colour on woodwork internally ÷ 8″		
					&		
					Knot prime stop and three coats of oil-colour on woodwork externally ÷ 8		
					Height of door . . 2/	6	7½
						13	3
					Width	2	6
						15	9
	15	9					
		4	5	3	Add *both* on frame ÷ 9		
	16	0					
		4	5	4	One coat red lead on back of deal frame		
					MAIN ENTRANCE DOOR		
2/	9	0					
	6	11	124	6	Knot prime stop and three coats of oil-colour on woodwork internally and externally . . ÷ 8		
					Height of door . . 2/	7	0
						14	0
					Width of door . . .	9	3
						23	3

(*continued*) **Painting**

	ft. in.	ft. in.		ft. in.
	23 0			
	8	15 4	Add last on frame . . ÷ 9	
	23 3		One coat red lead on back of	
	4	7 9	deal frame	

STEEL SASHES

4/2/	3 3			
	4 0	104 0	Two coats of oil-colour on steel sashes	

ROOF TIMBER

2/	21 6			
	10	35 10	Knot prime stop and three coats of oil-colour on fascia board . . ÷ 9	
2/	21 6			
	10	35 10	Ditto as last, on soffit board ÷ 9	
			Length of roof . . .	20 0
			Deduct joists . . 21/2"	3 6
				16 6
2/	16 6			
	9 6	313 6	Two coats of wood preservative on roof timber and boarding	Boarding
2/21/	9 9			
	10	341 3		Rafters
6/	11 0			
	1 4	88 0		Tie
	21 6			
	1 3	26 11		Ridge
2/	20 9			
	7	24 3		Wall plates
		793 11		

ABSTRACT AND ANALYSIS OF MATERIALS

A. CONCRETE

ABSTRACT

Section No.	1 : 6 Mix Feet Cube	Deduct	Section No.	1 : 2 : 6 Mix Feet Cube	Deduct	Section No.	1 : 2 : 4 Mix Feet Cube	Deduct
3	114 8	1 3	4	145 7		5	10 5	
13	1 2		15		9	19	5 3	1 2
19	12 0		19	2 0				
20	30 7	2 7					15 8	1 2
20	8 10			147 7	9	*Deduct*	1 2	
20	8 9		*Deduct*	9			14 6	= ½ yd. cube
	176 0	3 10		146 10 = 5½ yards cube				
Deduct	3 10							
	172 2 = 6⅓ yards cube							

ANALYSIS

The quantities of material required to make one yard cube of finished concrete are :—

For 1 : 6 mix : ·20 ton cement, 1·16 yards cube ballast.

1 : 2 : 4 mix : ·23 ton cement, ·43 yard cube sand, ·86 yard cube shingle or gravel 2″ down.

1 : 2 : 6 mix : ·18 ton cement, ·35 yard cube sand, 1·00 yard cube shingle or gravel 2″ down.

Total quantities of concreting material required are :—

Mix	Concrete as Poured	Cement	Sand	Shingle or Gravel	Ballast
	Yards Cube	Tons	Yards Cube	Yards Cube	Yards Cube
1 : 6	6·33	1·27	—	—	7·34
1 : 2 : 4	·50	·12	·22	·43	—
1 : 2 : 6	5·50	·99	1·93	5·50	—
		2·38	2·15	5·93	7·34

(Carried to Abstract R)

HARDCORE

Section No. 3 . . .	90·6 feet cube
Add 20% for consolidation and waste, etc. . . .	18 1
	108 7
	= 4 yards cube

(Carried to Final Quantities)

C. BRICKWORK

ABSTRACT

Section No.	Half-brick wall in Common Bricks		Section No.	One-brick wall in Common Bricks		Section No.	One-brick wall in Hard Stocks	
	Feet Super	*Deduct*		Feet Super	*Deduct*		Feet Super	*Deduct*
7	674 8	155 8	7	60 0		19	25 0	
7	39 8							
8	2 5							
20	5 11							
	722 8	155 8		60 0			25 0	
Deduct	155 8		*Deduct*	—		*Deduct*	—	
	567 0			60 0			25 0	
Deduct ⅔	378 0		*Deduct* ⅓	20 0		*Deduct* ⅓	8 4	
Reduced	189 0 Feet Super		Reduced	40 0 Feet Super		Reduced	16 8 Feet Super	

Note.—The brickwork has been "reduced" to a common thickness of one and a half bricks, viz., 13½", for easier computation of number of bricks.

To reduce half-brick walls to a thickness of one and a half bricks, it is necessary to deduct ⅔ of the quantity.

To reduce one-brick walls to a thickness of one and a half bricks, it is necessary to deduct ⅓ of the quantity.

(*continued*) **C. Brickwork**

ANALYSIS

To find the number of bricks required, " reduce " the various items of brickwork. The number of bricks required for a foot super of one-and-a-half-brick wall is 16.

Number of common bricks required, therefore, is :—

Half-brick wall reduced .	189 0 feet super			
One-brick wall reduced .	40 0 feet super			
	229 0	× 16	=	3,664 bricks
Add 10% for waste, cuttings, etc. .			=	366
				4,030 bricks

(Carried to Final Quantities)

Number of hard stock bricks required, therefore, is :—

One-brick wall reduced .	16 8 feet super			
	16 8	× 16	=	267 bricks
Add 10% for waste, etc.			=	27
				294 bricks

(Carried to Final Quantities)

D.' MORTAR

ANALYSIS

Assuming the size of common bricks to be 8¾" × 4¼" × 2⅝", the thickness of horizontal, or bed, joints with brickwork built four courses to one foot, will be ¼ (12" − 4/2⅝") = ⅜".

Taking an area of half-brick wall, 3′ 0" × 3′ 0", there will be 16/3′ 0" × 4¼" = 17′ 0" super of ⅜" bed joint = 6⅜" cube per yard super.

Therefore, for 567 feet super of half-brick wall, which equals 63 yards super, the quantity of mortar required will be 63 × 6⅜" = 33′ 6" feet cube.

With one-frog size, 5" × 2¾" × ⅞", to each brick, the quantity of mortar required will be :—

3,664 × 5" × 2¾" × ⅞" feet cube = 25′ 6" feet cube.

For one-brick wall the extra amount of mortar per yard super required for the vertical backing joints will be 3′ 0" × 3′ 0" = 9′ 0" of ¼" joint, which equals 2¼" cube per yard super. For the bed joint the quantity for the half-brick wall will have to be doubled.

Therefore, for 60 feet super, which equals 7 yards super, the quantity of mortar required will be 7 (2/6⅜" + 2¼") = 8′ 9" feet cube.

(*continued*) **D. Mortar**

For one-brick wall in hard stocks, size 9″ × 4½″ × 3″, built four courses to 13″, the bed joints will be ¼″ thick. Taking an area of 3′ 0″ × 3′ 3″ of one-brick wall, there will be :—

12/3′ 0″ × 9″	=	27′ 0″	¼″ bed joints
4/3′ 3″ × 9″	=	9′ 9″	¼″ Perpends
3′ 3″ × 3′ 0″	=	9′ 9″	¼″ backing joints

46′ 6″ × ¼″ = 11⅝″ cube per 9′ 9″ super

= 10′ 6″ cube per yard super.

Therefore, for 3 yards super, the quantity of mortar required will be: $\dfrac{3'' \times 10\frac{1}{2}''}{12}$ feet cube = 2′ 8″ feet cube.

Total Quantities

Half-brick wall in common bricks	. .	33′ 6″ feet cube
One-brick wall in common bricks	. .	8′ 9″ ,,
Frogs to both	. . . . .	25′ 6″ ,,
One-brick wall in hard stocks	. . .	2′ 8″ ,,
		70′ 5″ feet cube
		= 2⅝ yards cube

For mortar 1 : 3 the quantities of material required to make one yard cube of finished mortar are :—

·4 ton cement and 1·1 yards cube sand.

The amount of material required will be :—

1·06 tons cement.
2·92 yards cube sand.

(Carried to Abstract R.)

E. REINFORCING RODS
(Section No. 5)

Convert ⅜″ mild steel round rods into lb. by multiplying feet run of rod by 1 502 lb.

45′ 0″ feet run × 1·502 lb. = 68 lb.
= 2 qrs. 14 lb.

(Carried to Final Quantities)

F. TILE SILL
(Section No. 8)

28′ 0″ feet run tile sill of 6″ × 6″ quarry tiles will require	. .	56 tiles
Add breakages and waste	. .	6 ,,
		62 tiles

(Carried to Final Quantities)

G. SLATE DAMP-PROOF COURSE
(Section No. 8)

ABSTRACT

	4½″ Wide Feet Run	4½″ Wide Deduct	9″ Wide Feet Run	9″ Wide Deduct
	71 6	21 2	14 4	—
Deduct	21 2	—	—	—
	50 4		14 4	

For half-brick walls, assume slates 9″ × 4½″, and for 9″ walls 14″ × 9″.

Number of slates required will be :—

2/50′ 4″ ÷ 9″ = 134 slates
2/14′ 4″ ÷ 14″ = 25 slates

(Carried to Final Quantities)

H. FORMWORK

(Section No. 6)

1″ Wrot boarding to pit . . .	70 0	
Add 10% waste, etc. . .	7 0	
	77 0	feet super

(Carried to Final Quantities)

The formwork and strutting to the pit may be re-used for the lintols and the concrete covers to the manholes.

I. RENDERING

ABSTRACT

Section No.	1 : 3 ½″ thick	Section No.	1 : 4 Cube	Section No.	Cement and Sand Rendering to Brickwork with Rough-cast Finish — 1 : 4 (½″ thick)		Cement and Sand Rendering to Brickwork with Rough-cast Finish — Rough Cast (⅛″ thick)
	Feet Super		Feet Super		Feet Super	*Deduct*	Area as 1 : 4
9	13 10	10	7 2	11	796 8	137 3	render
12	13 1	11	4	11	15 3		=674′8″ feet super
19	32 6	20	1 3				at ⅛″ thick
	59 5		8 9	Feet Cube	811 11	137 3	=7 feet cube
=	2′ 6″ feet cube			*Deduct*	137 3		=¼ yard cube
					674 8	=28′2″	feet cube

1 : 3	1 : 4
2′ 6″	8′ 9″ 28′ 2″
2′ 6″ feet cube	36′ 11″ feet cube
=·09 yard cube	= say 1⅓ yards cube

ANALYSIS

The following quantities of material are required to make one yard cube finished rendering :—

1 : 2 mix : ·54 ton cement, ·99 yard cube sand.
1 : 3 „ ·4 ton cement, 1·1 yards cube sand.
1 : 4 „ ·3 ton cement, 1·1 yards cube sand.

Therefore materials required will be :—

Mix	Yards Cube	Cement	Sand	Shingle
		Tons	Yards Cube	Yards Cube
1 : 3	·09	·04	·1	—
1 : 4	1·33	·40	1·46	—
Rough Cast	—	—	—	·25
		·44	1·56	·25

(Carried to Abstract R)

J. MANHOLE COVER
(Section No. 19)

No. 2, 18″ × 18″ cast-iron manhole cover and frame

(Carried to Final Quantities)

K. DRAINS
(Section No. 20)

46′ 0″ feet run, 4″ salt-glazed stoneware drainpipe.

Length of drainpipe is 2′ 0″, excluding socket, therefore number of pipes required	=	23
Less pipe included in bends, 4/1	=	4
		19
Add waste, etc., 10%		2
		21 pipes

(Carried to Final Quantities)

The cement and sand necessary in the jointing assumed covered by Final Quantities.

L. TIMBER TO ROOF

TO ROOF

Sawn deal (1½ × 9 : 2 × 4 : 2 × 6 : 3 × 4), from Section No. 9	33′ 9″	feet cube
3 × 3 Strut, from Section No. 6	1′ 2″	,,
	34′ 11″	,,
Add 10% waste, etc.	3′ 6″	,,
	38′ 5″	feet cube
(Carried to Final Quantities)		
¾″ Sawn deal boarding, from Section No. 9 .	380′ 0″	feet super
Add 10% waste, etc.	38′ 0″	,,
	418′ 0″	feet super
(Carried to Final Quantities)		
1″ × 2″ Tile battens, rift sawn, from Section No. 9	1,189′ 0″	feet run
Add 10% waste, etc.	118′ 11″	,,
	1,307′ 11″	feet run
(Carried to Final Quantities)		
1½″ × 1½″ Wrot deal fillet, from Section No. 19	6′ 0″	feet run
Add 10% waste, etc.	7″	,,
	6′ 7″	feet run

(Carried to Final Quantities)

(continued) **Timber to Roof**

$2\frac{1}{2}'' \times 1''$ Tilting fillet, from Section No. 9	41′ 0″	feet run
Add 10% waste, etc.	4′ 2″	,,
	45′ 2″	feet run

(Carried to Final Quantities.)

TO PIT

(Section No. 15)

1″ Wrot deal boarding	23′ 4″	feet super

(Carried to Final Quantities)

$2'' \times 4''$ Wrot deal	14′ 0″	feet run
$2'' \times 4''$ Ditto, from Section No. 13	7′ 0″	,,
	21′ 0″	feet run

(Carried to Final Quantities)

M. TILING

(Section No. 10)

ANALYSIS

Tiles are $10'' \times 6\frac{1}{2}'' \times \frac{1}{2}''$ thick, laid to 4″ gauge, therefore the number of courses required $= \frac{9'\ 6''}{4''} = 28{\cdot}5$ courses each side, say 29 courses.

Length of roof = 21′ 6″, therefore the number of tiles per course $= \frac{21'\ 6''}{6\frac{1}{2}''} = 39{\cdot}7$ tiles, say 40 tiles.

Number of tiles required to cover 408′ 6″ feet super	$= 29 \times 40 \times 2$	=	2,320 tiles
Add extra course at eaves	$= 2 \times 40$	=	80 ,,
			2,400 tiles
Deduct verge tiles	$= 29 \times 4 \times \frac{1}{2}$	=	58 ,,
			2,342 ,,
Add 10% waste, etc.		=	234 ,,
			2,576 tiles

(Carried to Final Quantities)

Tile and half-tile at gables	$4/\frac{1}{2}/29$	=	58 tiles

(Carried to Final Quantities)

Ridge tiles, each 20″ long	$= \frac{21'\ 6''}{20''}$	=	13 tiles

(Carried to Final Quantities)

Composition nails every fourth course, i.e. 7 courses nailed each side.

Number of nails per course			79 nails
Total number of nails required for whole roof	$= 79 \times 7 \times 2$	=	1,106 nails
	say 7 lb.		

(Carried to Final Quantities)

N. FRAMES
(Section No. 12)

4″ × 3″ Wrot rebated frames . . . 23′ 9″

(Carried to Final Quantities)

4″ × 2½″ Ditto . 16′ 6″

(Carried to Final Quantities)

O. JOINERY TIMBER
(Section No. 13)

EXTERNAL JOINERY

1¼″ × 9″ Wrot Deal Fascia Grooved for Soffit Board	1¼″ × 10″ Wrot Deal Soffit Board, tongued One Edge
Feet Run 47′ 0″	Feet Run 43′ 0″

(Carried to Final Quantities)

INTERNAL JOINERY

	¾″ Wrot Deal	1″ Wrot Deal	1¼″ Wrot Deal	Three-ply Boarding	1″ × 1″ Triangular Fillet	1″ × 9″ Wrot Deal	1½″ × 2″ Wrot Deal	2″ × 2″ Wrot Deal
	Feet Super 12 10	Feet Super 15 0 4 8	Feet Super 49 3	Feet Super 12 9	Feet Run 8 10 10 8	Feet Run 15 0	Feet Run 14 0	Feet Run 55 0 92 3
	12 10	19 8	49 3	12 9	18 8	15 0	14 0	147 3
Add 10% Waste, etc.	1 3	2 0	4 11	1 3	1 10	—	—	14 9
	14 1	21 8	54 2	14 0	20 6	15 0	14 0	162 0
					=11′0″ out of 1″ × 1½″			

(Carried to Final Quantities)

P. RAINWATER GOODS
(Section No. 17)

6″ Half-round asbestos cement eaves gutter, 43′ 0″ feet run = No. 7 lengths of gutter 6′ 0″ long.

4″ Asbestos cement rainwater pipe, 18′ 8″ feet run = No. 3 lengths of rainwater pipe 6′ 0″ long.

(Carried to Final Quantities)

Q. PAINTING
(Section No. 22)

ABSTRACT

Clearcolle and Once Distemper Brickwork		Knot, Prime Stop and Two Coats of Oil-colour on Woodwork ÷ 8	÷ 9	Knot, Prime Stop and Three Coats of Oil-colour on Woodwork ÷ 8	÷ 9	Red Lead on Back of Frame	Two Coats of Oil-colour on steel Sashes	Two Coats of Wood Preservative
Feet Super	*Deduct*	Feet Super	Feet Super	Feet Super	Feet Super	Feet Super	Feet Super	Feet Super
687 1	137 3	16 3	5 3	16 3	5 3	5 4	104 0	793 11
18 11				124 6	15 4	7 9		3 0
					35 10			
					35 10			
706 0	137 3	16 3	5 3	140 9	92 3	13 1	104 0	796 11
137 3	Add ⅛th	2 0	Add ⅛th	17 7				
568 9		18 3	18 3	158 4	158 4			
			23 6		250 7			

Note.—It will be assumed that the finishing coat for doors and windows will be the same colour.

ANALYSIS

	Distemper	Knotting	Priming	Oil-colour 1st Coat	Oil-colour 2nd Coat	Oil-colour 3rd Coat	Wood Preservative 1st Coat	Wood Preservative 2nd Coat
	Feet Super 568 9	Feet Super 23 6 250 7	Feet Super 23 6 250 7 13 1	Feet Super 23 6 250 7 104 0	Feet Super 23 6 250 7 104 0	Feet Super 250 7	Feet Super 796 11	Feet Super 796 11
	568 9	274 1	287 2	378 1	378 1	250 7	796 11	796 11
Yards Super	63	31	32	42	42	28	89	89
	Covering Capacity (in yards super)							
1 cwt. covers	300	—	—	—	—	—	—	—
1 gal. covers	—	—	50	70	75	80	90	95
	Quantities required							
	Cwts.		Gals.	Gals.	Gals.	Gals.	Gals.	Gals.
	·21	—	·64	·60	·56	·35	1·0	·94
Add 10% waste etc.	·02	—	·06	·06	·06	·03	·1	·09
	·23	—	·70	·66	·62	·38	1·1	1·03 1·1
								2·13

(Carried to Final Quantities)

R. SAND AND BALLAST SUMMARY

Reference	Cement	Sand	Shingle	Ballast	Building Sand
	Tons	Yards Cube	Yards Cube	Yards Cube	Yards Cube
Abstract A ..	2·38	2·15	5·93	7·34	—
D ..	1·06	—	—	—	2·92
I ..	·44	—	·25	—	1·56
	3·88	2·15	6·18	7·34	4·48
Add 10% waste, etc.	·39	·22	·62	·73	·45
	4·27	2·37	6·80	8·07	4·93

(Carried to Final Quantities)

FINAL QUANTITIES FOR ORDERING

SAND AND BALLAST

8 yards cube	" All in " Ballast . . .	@	per yard cube
7 do.	Clean washed shingle . .	@	do.
3 do.	Clean washed sand for concrete	@	do.
5 do.	Clean washed building sand .	@	do.
4 do.	Hardcore	@	do.

CEMENT

4¼ tons	Portland cement	@	per ton

BRICKS, ETC.

4,000	Fletton bricks	@	per thousand
300	Hard-burnt stock bricks . . .	@	do.
60	6″ × 6″ Quarry tiles	@	do.
140	Stout slates for damp-proof course, size 9″ × 4½″	@	do.
30	Ditto size 14″ × 9″	@	do.

DRAINPIPES

21	4″ " Best Quality " salt-glazed stoneware drainpipes with spigot and socket ends	@	each
3	4″ Easy bends on last.	@	each
1	4″ Access bends ditto	@	each
1	4″ Junctions ditto	@	each
2	Salt-glazed stoneware trapped gulleys with 4″ outlet and 6″ × 6″ cast-iron grating	@	each
1	Salt-glazed stoneware yard gulley with 4″ outlet and 9″ × 9″ cast-iron grating	@	each
8 lb.	Yarn gasket	@	per lb.

REINFORCEMENT

2 qrs. 14 lb.	¾″ diameter mild steel rod reinforcement cut to lengths and hooked as detail	@	per cwt.

ROOFING TILES

2,600	10½″ × 6½″ × ½″ Approved roofing tiles	@	per thousand
60	10½″ × 9¾″ × ½″ "Tile and a half" tiles to match approved roofing tiles	@	per hundred
13	12″ diameter half-round ridge tiles .	@	do.

TIMBER

39 feet cube	Deal, sawn all round (1½″ × 9″: 2″ × 4″ : 2″ × 6″ : 3″ × 3″ : 3″ × 4″ .	@	per foot cube
4 squares 20 feet super	¾″ Sawn square-edge roof boarding . .	@	per square
25 feet super	1″ Sawn square-edge boarding . . .	@	do.
80 feet super	1″ Wrot ditto for shuttering . . .	@	do.
15 feet super	¾″ Wrot deal boarding	@	do.
22 feet super	1″ Wrot deal boarding	@	do.
55 feet super	1¼″ Wrot deal boarding	@	do.
14 feet super	Three-ply boarding ½″ thick	@	per foot super
11 feet run	1″ × 1½″ Wrot deal fillet .	@	per foot run
1,300 feet run	1″ × 2″ Tile battens, rift sawn	@	do.
45 feet run	1″ × 2½″ Sawn deal tilting fillet	@	do.
15 feet run	1″ × 9″ Wrot deal . .	@	do.
47 feet run	1¼″ × 9″ Wrot deal fascia board grooved for soffit board	@	do.
43 feet run	1¼″ × 10″ Wrot deal soffit board, tongued one edge .	@	do.
7 feet run	1½″ × 1½″ Wrot deal fillet .	@	do.
14 feet run	1½″ × 2″ ditto . .	@	do.
162 feet run	2″ × 2″ Wrot deal . .	@	do.
21 feet run	2″ × 4″ ditto . .	@	do.
17 feet run	2½″ × 4″ Wrot deal rebated frame	@	do.
24 feet run	3″ × 4″ ditto . . .	@	do.
14 feet run	½″ × 1″ Hardwood fillet .	@	do
14 feet run	1″ × 2″ Hardwood runner .	@	do.
18 feet run	2″ × 2″ ditto . . .	@	do.

JOINERY

1	2″ Deal framed, ledged and braced doors, 2′ 6″ × 6′ 6″, with 2″ × 4″ hanging stiles, rebated for boarding 2″ × 4″ rebated head, 1″ × 6″ ledge, and 1″ × 8″ bottom rail, the whole framed together and with 1″ tongued, grooved and V-jointed boarding screwed on, and with 2″ × 3″ weather board screwed on	@	each
1	Pair 2″ Deal-framed, ledged and braced doors, 9′ 0″ × 6′ 10½″ overall, with 2″ × 4″ hanging stiles rebated for boarding, 2″ × 4″ twice rebated meeting stiles, 2″ × 4″ rebated head rail, 1″ × 6″ ledges, 1″ × 9″ bottom rail, the whole framed together, and with 1″ tongued, grooved and V-jointed boarding screwed on, and including 2″ × 3″ weather board screwed on . . .	@	each

IRONMONGERY

Note.—All Ironmongery to have screws supplied.

2	Pairs 18″ steel strap hinges . .	@	per pair
1	12″ stout jointed locking bar . .	@	each
1	2″ 4-lever padlock with two keys .	@	each
1	18″ monkey-tail iron bolt with ¾″ shoot and socket for letting into concrete .	@	each
1	9″ iron barrel bolt and socket . .	@	each
2	Sets 4″ brass cabin hooks and eyes .	@	per set
1	Pair 4″ brass butts	@	per pair
1	6″ rimlock and set of bakelite furniture	@	each
6	14″ japanned iron shelf brackets . .	@	each
4	4″ brass drawer pull handles . .	@	each
24	2″ × 2″ × ⅛″ steel buttons for bench top	@	each
2	4″ brass flush lifting rings . . .	@	each

SMITHS' WORK

4	Wrot iron dowels, 2″ long, for door frame	@	each
12	Wrot iron cramps, ⅛″ × 1″ and 9″ long, one end bent for screwing to door frame, other end split for building into brickwork	@	each
6	½″ diameter bolts, 4″ long, ragged one end for building in, and threaded other end, including nut and washer .	@	each
2	18″ × 18″ cast-iron manhole cover and frame	@	each
4	Standard metal windows in eight squares, overall size 3′ 3″ × 4′ 0″, with one top square, top hung to open outwards, including casement stay and fastener, and with lugs riveted on for building into brickwork	@	each

RAINWATER GOODS

7	6′ 0″ lengths 6″ half-round asbestos cement eaves gutter with spigot and socket ends	@	per foot run
2	Stop ends for spigot for last	@	each
2	Stop ends for socket for last	@	each
2	Nozzle on 6″ half-round eaves gutter with 4″ outlet	@	each
12	Galvanised-iron gutter brackets for screwing to deal	@	each
3	6′ 0″ lengths 4″ asbestos cement rain-water pipe	@	per foot run
2	Swan-necks to 4″ pipe, 15″ projection	@	each
2	Plinth bends to ditto 6″ projection	@	each
2	Shoes to ditto	@	each
4	Galvanised-iron pipe clips for plugging and screwing to brickwork	@	each

PLUMBERS' MATERIAL

4 feet run	¾″ galvanised wrot iron barrel-tubing (water quality)	@	per foot run
2	¾″ galvanised wrot iron elbow (ditto)	@	each
1	¾″ galvanised-iron pipe clip	@	each
1	¾″ brass bib-tap, with nozzle for hose union	@	each

GLASS

4 pieces	24 oz. clear sheet glass, 10⅜″ × 17⅛″, cut to size	@	per foot super
12 pieces	Ditto 11⅜″ × 18¼″ ditto	@	do.
16 pieces	Obscured glass, 11⅜″ × 18¼″ ditto	@	do.
8 lb.	Putty	@	per lb.

PAINT

¼ cwt.	Distemper	@	per cwt.
¾ pint	Shellac knotting	@	per pint
¾ gallon	Priming	@	per gallon
¾ gallon	White lead paint, tinted	@	do.
¾ gallon	Ditto	@	do.
½ gallon	Ditto	@	do.
2¼ gallons	Wood preservative	@	do.

SUNDRY MATERIAL

7 lb.	1″ oval wire nails	@	per cwt.
28 lb.	2″ ditto	@	do.
7 lb.	Composition nails for tiling	@	do.
3 gross	1″ steel round-head screws	@	per gross
3 gross	2″ ditto	@	do.
1 gross	4″ ditto	@	do.

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